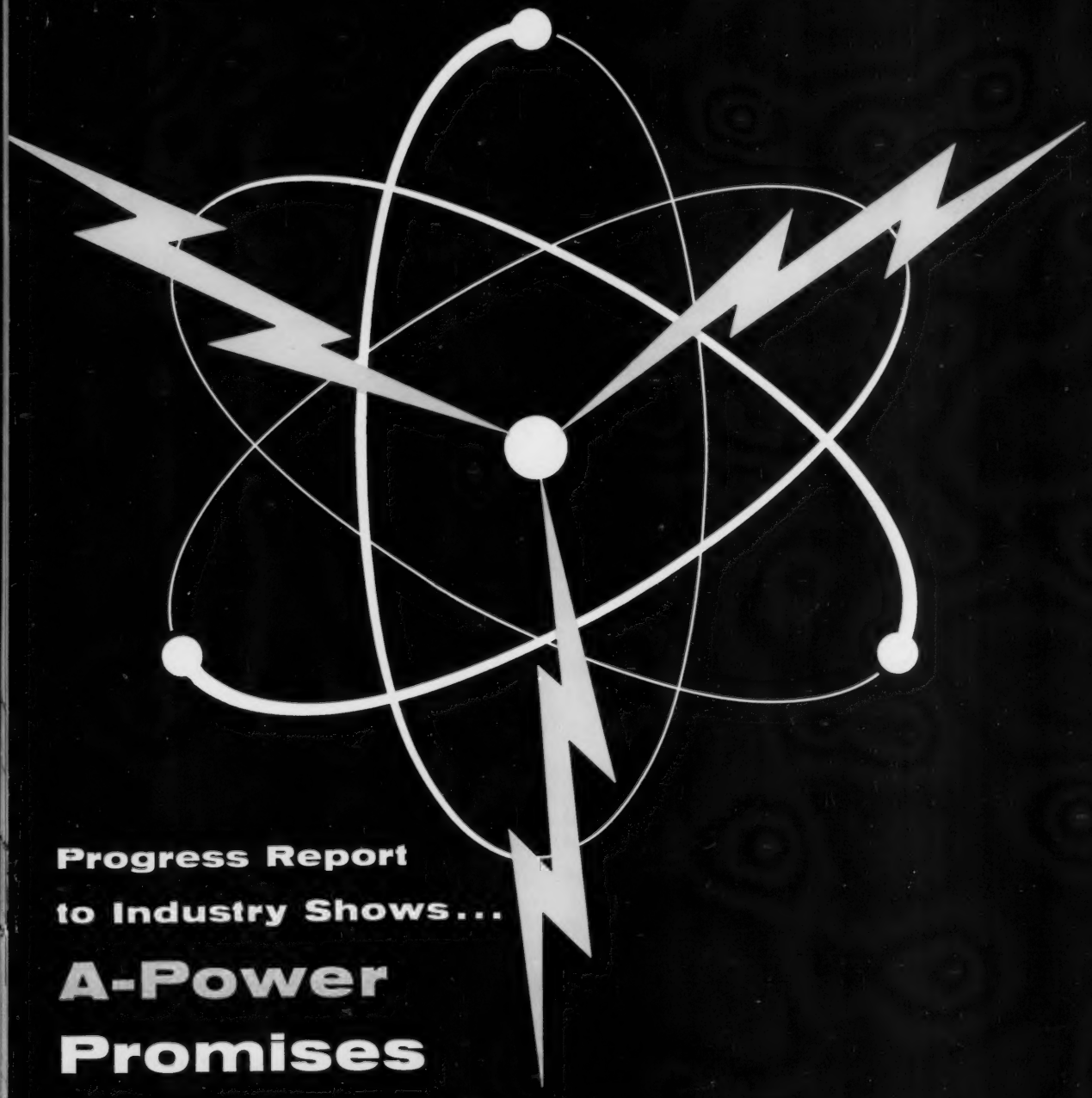
The Electrical Industry's Weekly Magazine

May 28, 1956

Electrical World

Price 35 Cents

A McGraw-Hill Publication



Progress Report to Industry Shows...

A-Power Promises to Compete

...Page 127

Keep system clean... no sludge, no rust, no foam

YOU CAN best assure clean turbine systems by lubricating with *Texaco Regal Oil R&O* — the oil especially refined and processed to *prevent* sludge, rust and foam.

Texaco Regal Oil R&O is premium quality oil. It has notably high resistance to oxidation and an exceptionally long service life. It keeps bearing temperatures normal and governor response instantaneous.

There is a complete line of *Texaco Regal Oils R&O* meeting the strict requirements of all leading turbine builders for all types and sizes of turbines.

Let a Texaco Lubrication Engineer help you step up efficiency of all your power plant equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring JIMMY DURANTE on television . . . Saturday nights, NBC.

Fischer Black, Publisher and Editor
Jesse Mock.....Asst to the Editor

Daniel T Braymer.....Managing Editor
Leonard M Olmsted.....Associate Editor
Kenneth K Kost.....Associate Editor
Herbert R Frankel.....Associate Editor
Rue M Shoop.....Associate Editor
George Swift.....Associate Editor
Edward Allen.....Midwestern Editor
H S Knowlton.....New England Editor
John J Kearney....Middle Eastern Editor
Francis Kovalcik.....Western Editor
Allen Long.....Northeastern Editor
David Rea.....Southeastern Editor
E Bryson Sessions.....Commercial Editor
Robert Rush.....News Editor
Arthur J Stegeman.....Assistant Editor
James G Plunkett.....Assistant Editor
Denise Hennessy.....Editorial Assistant
Theodore W Fuller.....Editorial Assistant
Ary Mossiman.....Mgr, Market Research
Frank C Stockman.....Art Director
H T Howland, Jr.....Production Editor
G B Bryant, Jr...Mgr, Washington Bureau
V C Richter....Washington Correspondent
Dexter M Keezer.....Dir, Economics Dept
E Benoit-Smullyan.....Economist
A E Knowlton.....Consulting Editor

Domestic News Service: Atlanta, Chicago, Cleveland, Detroit, Houston, San Francisco.

World News Bureau: John Wilhelm, Editor Bombay, Bonn, London, Mexico City, Paris, Rio de Janeiro, Tokyo.

Warren W Shaw.....Sales Manager

District Managers: N V Palmer and E S Chapin, New York; E S Chapin, Boston; F P Coyle, Philadelphia; M S Kearney, Cleveland; M I O'Connell, Detroit; W H Meneilley and J T Schaefer, Chicago; J T Schaefer, St. Louis; C W Dysinger, Los Angeles; R C Alcorn and T H Carmody, San Francisco; William Lanier, Atlanta; G L Jones, Jr, Dallas.

Otto Drechsel.....Business Manager

ELECTRICAL WORLD

Published weekly by McGraw-Hill Publishing Co., Inc., Executive, Editorial and Advertising Offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Office, 99-129 North Broadway, Albany 1, N. Y.

Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph F. Gerardi, Executive Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.

Subscriptions: Address correspondence to Electrical World—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address.

Subscriptions are solicited only from executive, supervisory, and engineering personnel in electric utilities, manufacturing companies, and related fields. Position and company connection must be indicated on subscription orders.

Single copies 35¢. For the United States and possessions and Canada, $6 a year, $9 for two years, $12 for three years. Other Western Hemisphere, and the Philippines, $15 for one year, $25 for two years, $30 for three years. All other countries, $25 for one year, $40 for two years, $50 for three years. Entered as second class matter at the Post Office at Albany, N. Y. Printed in USA. Copyright 1956 by McGraw-Hill Publishing Company, Inc. Permission required to reproduce any of contents.

Electrical World

Published for 82 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Vol. 145 No. 22 **May 28, 1956**

ELECTRICAL WORLD'S INDUSTRY REPORT

A-POWER PROMISES TO COMPETE 127

MANAGEMENT

EEI'S 19TH SEMIANNUAL POWER SURVEY 120
Electrical Business Outlook 19
Statistics 20
Your Business 21
Public Relations 258
Finance and Regulation 262

GENERATION

COMMUTATOR-LESS EXCITER WORKS WELL .....W. C. Kaldenberg 122
OG&E ADDS 170-MW UNIT IN 22 MONTHS
R. F. Danner and A. R. Le Bailly 124
CAR DUMPING CONTROL FITTED TO NEED AHEAD 160
PLANT FIRE PLAN SAVES UTILITY'S 30-YEAR RECORD..D. E. Woods 175

SUBSTATIONS

MOBILE EQUIPMENT SPEEDS OIL MAINTENANCE .....K. F. Buel 155

TRANSMISSION

WORK CAGE TRAVELS GUY OF HIGH MASTS 166
'BUBBLE BOTTLE' DETECTS LEAKS IN 34.5-KV CABLE..J. L. Redmond 170

ENGINEERING REFERENCE SHEET 168

SALES AND SERVICE 186

INDUSTRIAL APPLICATIONS 180

INDUSTRY NEWS

Electrical Week 112
Current Events 114, 244, 248
Manufacturers and Markets.. 224
News About People 232
Sales Assignments 236
Meetings Calendar 240

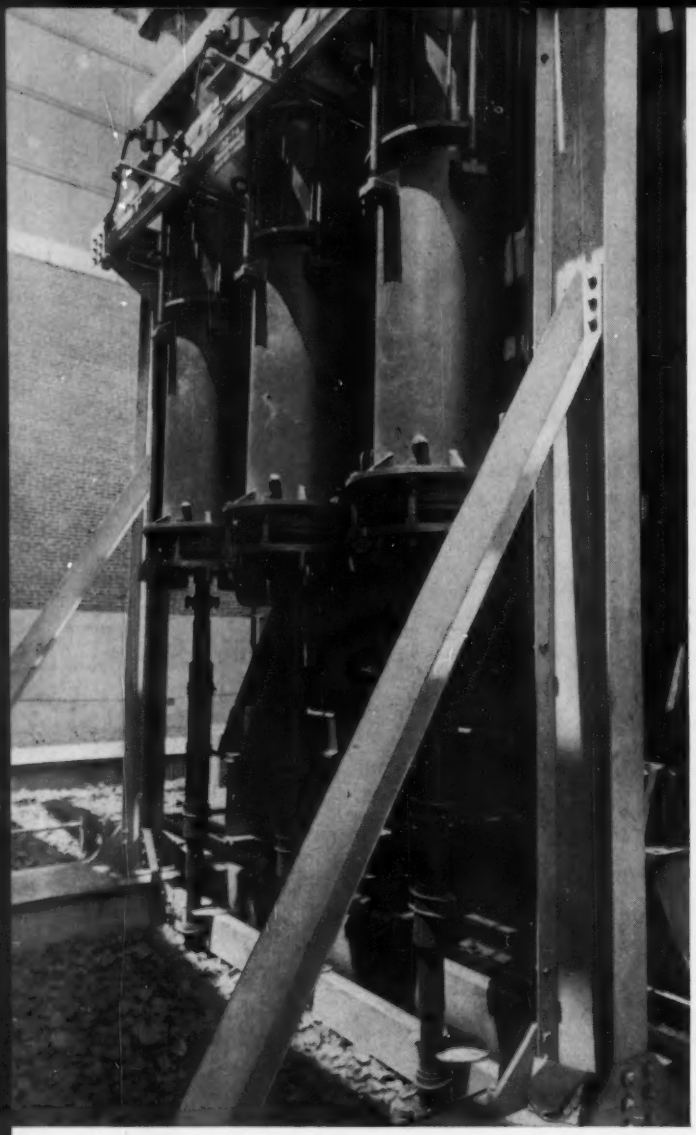
EQUIPMENT NEWS

New Equipment 198
Technical Literature 214
Catalogs and Bulletins 210

EDITORIAL AND COMMENTARY

Technical Notes 22
Washington Comment 22
Editorials 111
Books 215

INDEX OF ADVERTISERS 267



This 132kv Oilostatic system three phase termination direct to the high voltage side of the transformer eliminates exposed bus structures, bushings and potheads. The self-contained termination saves space and provides maximum safety because all "live" parts are enclosed.

Oilostatic transformer termination eliminates exposed bus structures

Advantages of a self-contained metal-clad transformer termination are evident from the photo at left. This neat, compact termination, being completely enclosed, insures maximum safety by eliminating exposed bus structures, bushings and potheads. Since 1949 this type of Oilostatic termination has been operating satisfactorily.

The installation shown is the termination of a 132kv Oilostatic system recently purchased by Public Service Electric and Gas Company of New Jersey. This system, *developed originally by Okonite*, consists of paper-insulated cables installed in a welded steel pipe filled with oil maintained at 200 psi.

Proof that Public Service Electric and Gas Company of New Jersey can expect to get outstanding performance from this installation is their previous experience with Oilostatic systems that date back to 1940. In addition, Oilostatic systems have been in successful operation elsewhere since 1932 and have recently been installed for operation at 230kv.

For information on Oilostatic systems, write for Bulletin EW-1044. Address: The Okonite Company, Passaic, N. J.

3755

Section of a typical Oilostatic system

Available with either copper or aluminum conductors

OKONITE SINCE 1878 *insulated cables*

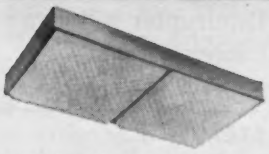
GraybaR FEATURE FIXTURES for 56!

Out of the hundreds of quality lighting fixtures Graybar distributes, these *Feature Fixtures for '56* have been selected as worthy of the particular attention of your commercial, industrial and residential lighting customers.

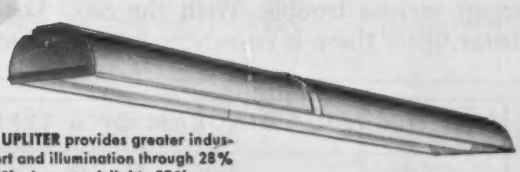
Some of these Feature Fixtures are now on display at Graybar locations from coast-to-coast and we have extended an invitation to your customers (you're welcome, too) to stop in and see them. At Graybar they will find the services of trained lighting experts to aid in the study, planning and selection of any type of lighting system. For, whatever the lighting requirements, Graybar can impartially recommend the best lighting system for any need.

That is why, when you back up your recommendations with Graybar as supplier, you can be sure the light will be right for the job... the *right* unit ...the *right* quality...the *right* characteristics.

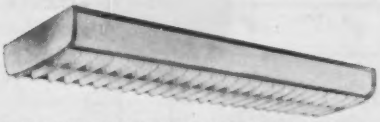
658-95



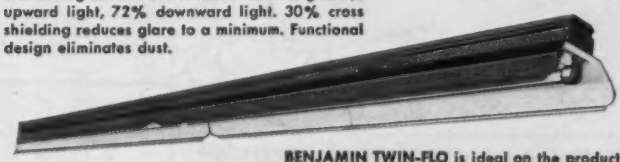
AREA/LITER has plastic diffusing panel more than twice the usual area, greatly reducing brightness, without cutting fixture light output. Provides freedom from glare, wide distribution of light, relief of monotony.



WHEELER BI-FLO UPLITER provides greater industrial seeing comfort and illumination through 28% upward light, 72% downward light. 30% cross shielding reduces glare to a minimum. Functional design eliminates dust.

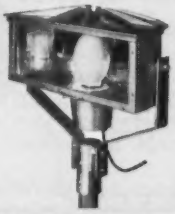


PITTSBURGH GARFIELD-ARTHUR SERIES feature shallow, sweeping lines and overall grace and beauty. Garfield series for surface mounting, flush against ceiling. Arthur units for pendant mounting with gracefully curved ends.

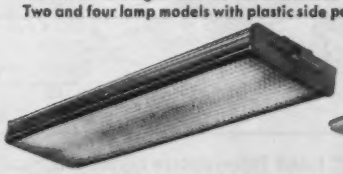


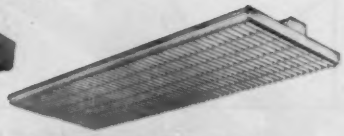
BENJAMIN TWIN-FLO is ideal on the production line, in drafting rooms, testing and inspection areas, etc. Two models (open end, shown, and closed-end Stream-Flo) available for single or continuous mounting.

WILSON WIDE LIGHT is designed for fluorescent mercury vapor lamps. Achieves greater light output and efficiency with less power consumption. Ideal for "daylighting" large outdoor areas.



WAKEFIELD GRENADIER is ideal where fine lighting plus attractive appearance are factors. Mount as a single unit or in continuous runs. Two and four lamp models with plastic side panels.

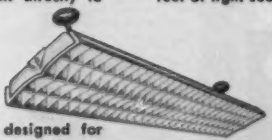




SILVRAY SILVER DOT furnishes controlled light, plus easy relamping, low lamp cost, compactness and a choice of a wide range of fixtures for any accent or general lighting.

CURTIS EDGE-GLO direct-indirect fluorescent luminaires series offer a variety of lenses and louvers for different lighting requirements. Suspend from the ceiling via hangers or mount directly to the ceiling.

SMITHCRAFT DIRECTOR fluorescent unit embodies beauty, easy maintenance, high level illumination. The eight-foot, six-light model provides over 24 square feet of light source.



MOE DRUM LIGHT has genuine pure white Opal Glass bowl. Easily converted to pull chain. Chromium finish.

DAY BRITE LUVEX-4 is designed for areas where close-tolerance work is carried on. Efficient, glare-free illumination is provided for minimum eye strain. Easy to install.

CALL GRAYBAR FIRST FOR...

Everything Electrical

*GraybaR ELECTRIC COMPANY

Since 1869 * REG. U.S. PAT. OFF.

IN OVER 130 PRINCIPAL CITIES

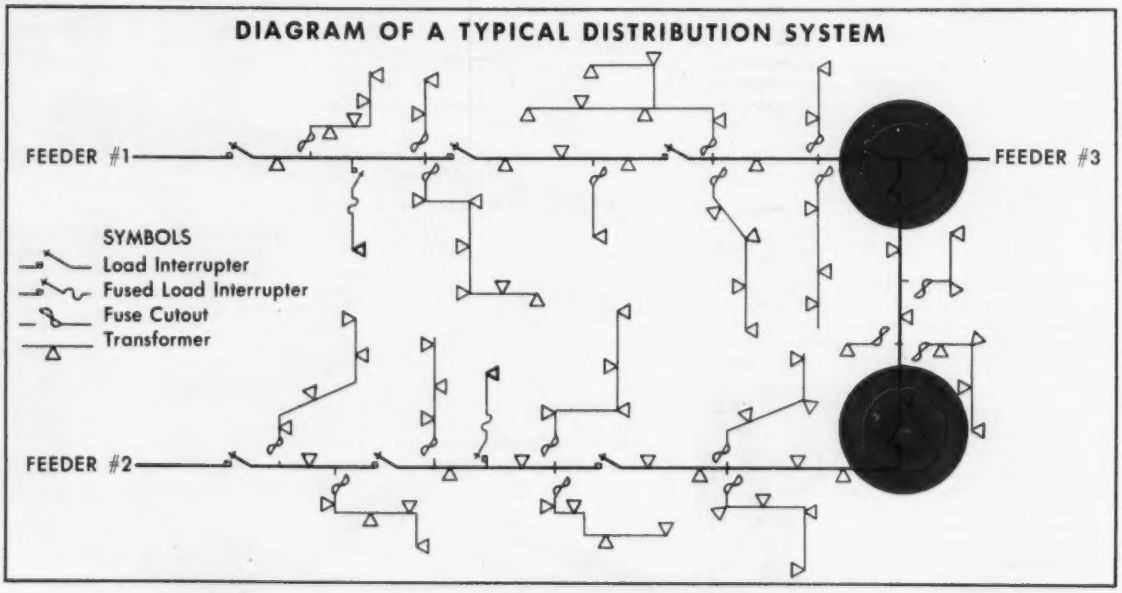
GRAYBAR ELECTRIC COMPANY, INC., 420 Lexington Avenue, New York 17, N. Y.

ARE BIGGER LOADS BRING IN SWITCHING YOUR 12 KV

With S&C Load Interrupters you can handle *all* switching duties on a typical distribution feeder—any load current, charging current, or magnetizing current.

With conventional disconnects or horn gaps, higher voltages and higher currents can mean serious trouble. With the S&C Load Interrupter there is no external arc, no danger of flashover, no hazard to personnel, no uncertainty. It can open the circuit *under any condition* except short circuit.

Whether your switching problem is at a feeder tie (see illustration below), at a sectionalizing point on a feeder, or at a branch tap, the S&C Load Interrupter will give you safe, positive, circuit interruption.



Typical application of S&C Load Interrupters (symbol) on distribution feeders. Circled in blue are specific cases—feeder tie points. Even here increased loads have made switching difficult in spite of the fact that parallel circuits are easier to open. Load Interrupters may be opened or closed on full line voltage and full load current—a real advantage during emergency conditions and a definite convenience under *normal* circumstances.

S&C

LOAD INTERRUPTER

Specialists in High-Voltage Circuit Interruption since 1910

S&C ELECTRIC COMPANY

ING BIGGER HEADACHES DISTRIBUTION FEEDERS?

Performance Comparison of Switching Devices

PERFORMANCE	S&C Load Interrupters		Conventional Disconnects	
	Stick-Operated	Group-Operated	Stick-Operated	Group-Operated
Interrupt current from parallel sources safely?	YES	YES	DOUBTFUL	DOUBTFUL
Safe to equipment or personnel if inadvertently opened on full voltage (in case loop is open)?	YES	YES	NO	DOUBTFUL
Dump load without opening feeder breaker, or without preliminary unloading?	YES	YES	NO	DOUBTFUL
Multi-pole device controllable from ground (may be required by system practice or other circuits on same pole)?	NO	YES	NO	YES
Simple to install?	YES	NO	YES	NO
Cost?	LOW	HIGHEST	LOWEST	HIGH

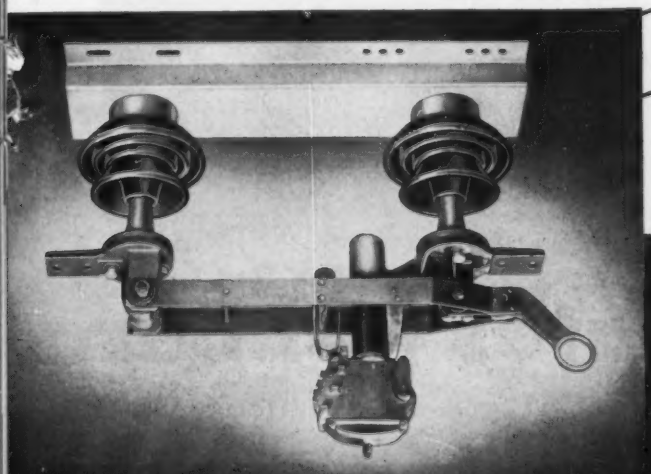
ABOUT THE S&C LOAD INTERRUPTER

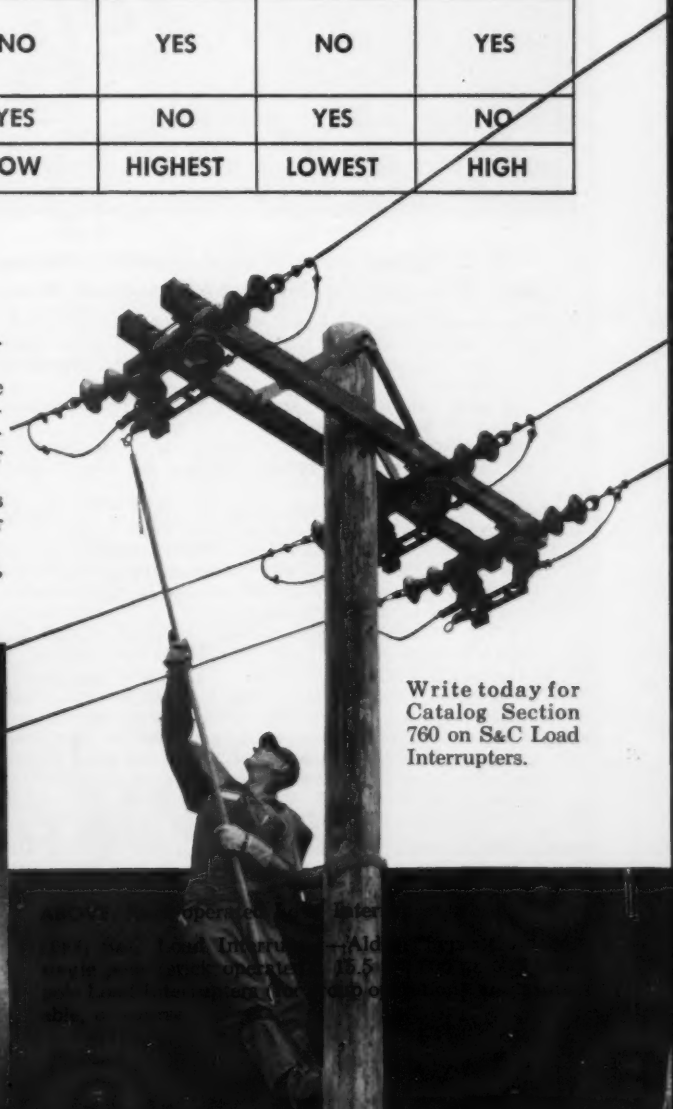
It can switch the circuit without unloading preliminaries and without opening the main breakers.

Switching cannot lead to dangerous phase-to-phase or phase-to-ground faults, because there is NO EXTERNAL ARC. Hence, there is no danger to men or equipment, even in case of inadvertent operation under emergency conditions.

It interrupts all load currents and charging currents instantly, making a clean, decisive break. The operator doesn't have to "dog" it.

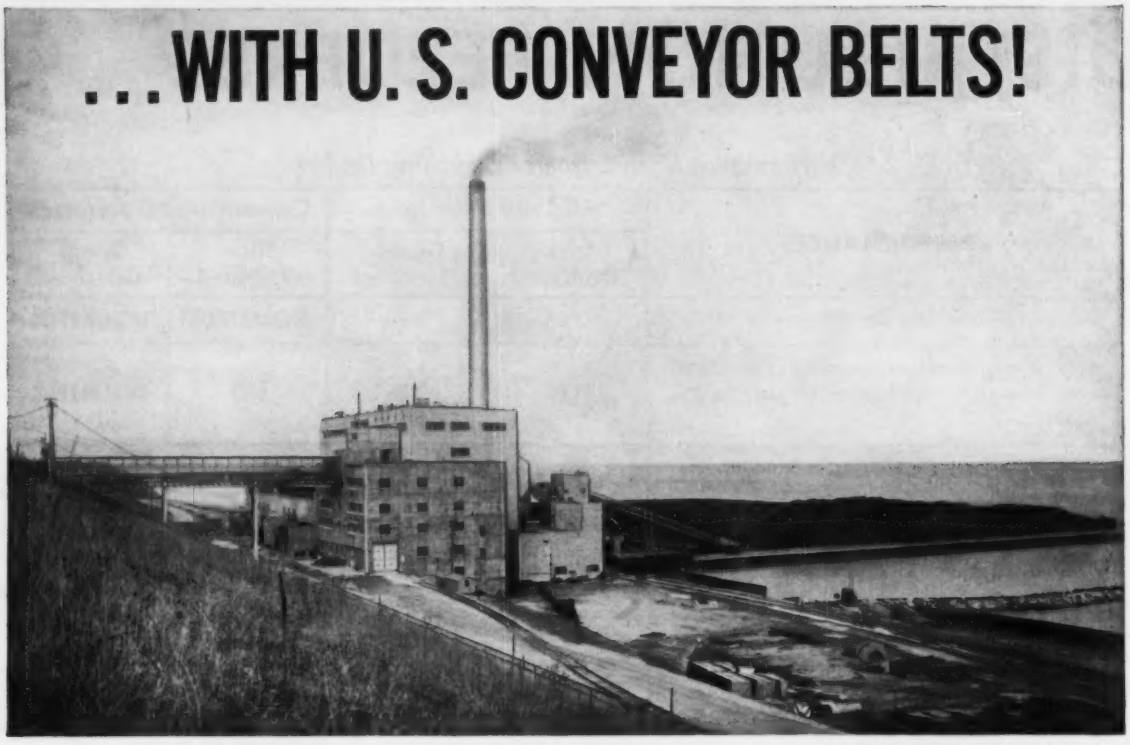
It can be mounted in any desired position—vertical, upright, or inverted.





Write today for Catalog Section 760 on S&C Load Interrupters.

MOVING 4100 TONS OF COAL PER DAY ...WITH U. S. CONVEYOR BELTS!



Partial view of new Oak Creek plant of Wisconsin Electric Power Co.

"'U. S.' gives us best coal-moving efficiency possible," says the cost engineer of Wisconsin Electric Power Co.

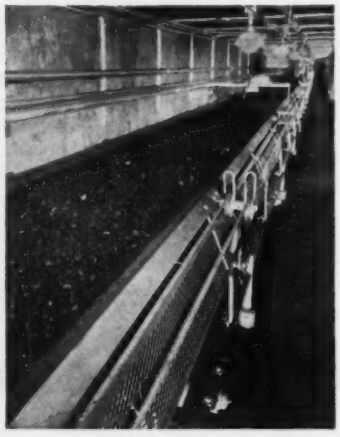
The immense new Oak Creek generating plant of Wisconsin Electric Power Co. is the largest and most modern in the entire state. Total planned capacity: 500,000 kilowatts... to feed the ever-growing demands of Wisconsin homes and industries.

It takes well over 4100 tons of coal per day to produce such a tremendous amount of power. And to move this amount of coal, Wisconsin Electric has installed United States Rubber Conveyor Belts. Says Mr. H. Jorgenson, the plant's cost engineer, "the U. S. belts help give us the finest coal-moving efficiency possible."

"U. S." products are not newcomers with Wisconsin Electric. "U. S." belts have been working there for more than twenty years.

"PULVERIZED COAL HAS TO BE HANDLED LIKE DYNAMITE," says Mr. Jorgenson. That's why throughout the plant you will find fire protection equipment of the most advanced type, and U. S. Peerless® is the brand of water hose hooked up to the system.

"THE ENTIRE GENERATING SYSTEM IS ALIVE WITH CONSTANT EXPANSION AND CONTRACTION, BECAUSE OF MANY HEAT CHANGES AND PRESSURES." That's why Wisconsin Electric cushions its power plant piping systems with U.S. Expansion Joints—to counteract the destructive effects of expansion, contraction and misalignment. Utility companies throughout the country not only depend on the *excellence* of "U.S." products but on the "constant vigilance" of "U.S." engineers in periodically checking up on "U.S." product performance, plus giving engineering and technical help whenever needed. Get in touch with any of the 27 "U.S." District Sales Offices, or write to us at Rockefeller Center, New York 20, N. Y.



"U. S." 48-inch conveyor belt.

US RUBBER

Mechanical Goods Division

United States Rubber

NOW... greater piping loads, longer travels, with less headroom

The Grinnell Model R Constant-Support Pipe Hanger is available now in an *extended range* of sizes to provide completely overlapping coverage of loads from 47 lbs. to 32,267 lbs., and with travels up to 12 inches. New design modifications permit these hangers to be installed with a minimum of headroom, ranging from 29 inches (rod take-out) for the largest size — down to 10¾ inches for the smallest size.

The Model R provides constant support which is mathematically perfect for all positions of travel. This constancy of support is maintained throughout the full range of field adjustability. Needle bearings minimize friction.

Grinnell Constant-Supports are individually calibrated to support the exact load specified. All Model R Constant-Supports have a full 70 percentage points of field adjustability built into them. No less than 10% of this adjustability is allowed either side of calibration for plus or minus change in load. Field re-adjustments are easily made by turning a single load adjustment bolt.

Grinnell designs, manufactures, and distributes a complete line of pipe hangers and supports for every piping requirement. Grinnell maintains an experienced staff of engineers in the field — ready to assist you on the job with any piping problem.

GRINNELL

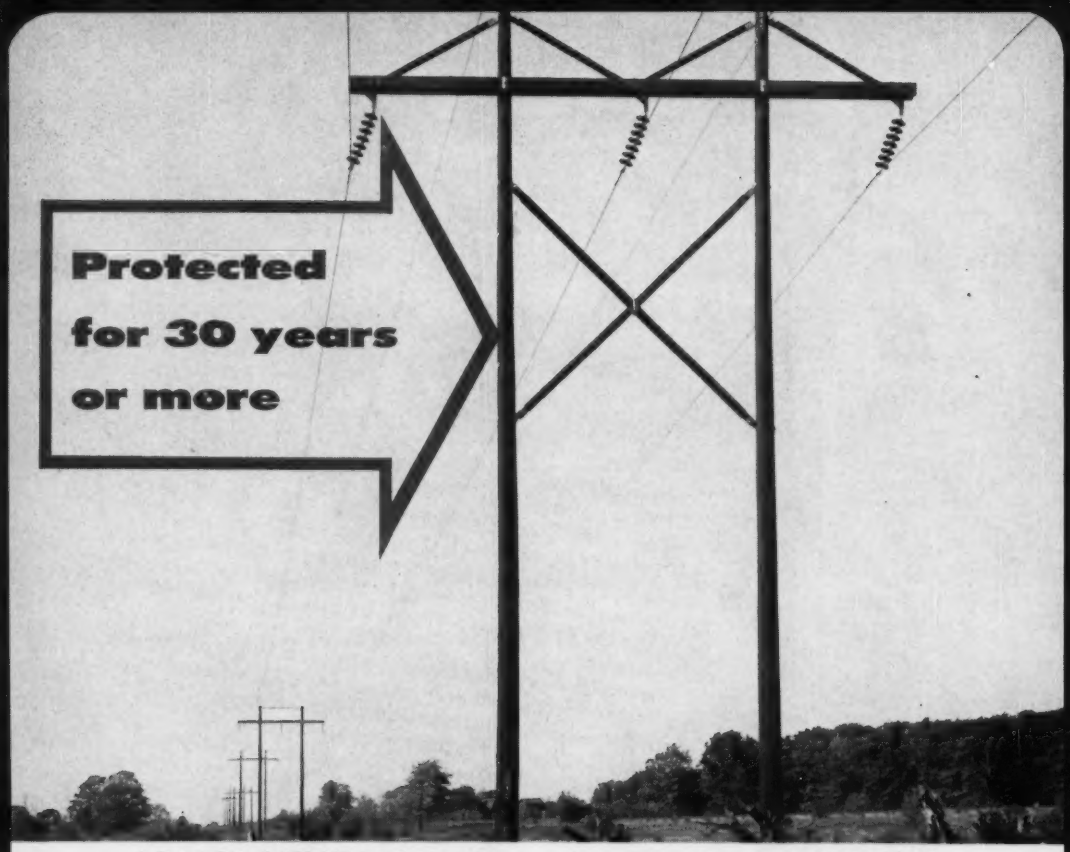
AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island — **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

DETROIT EDISON REPORTS:

We use clean Penta-treated poles for long service life under severe weather conditions



In Detroit Edison's 120,000-volt "H"-frame line, supporting poles are Penta-treated. Heavy treatment means maximum protection against decay. Because Penta won't bleed or leach out to burn hands, pole handling and installation are easier, faster and more pleasant.

Detroit Edison says:

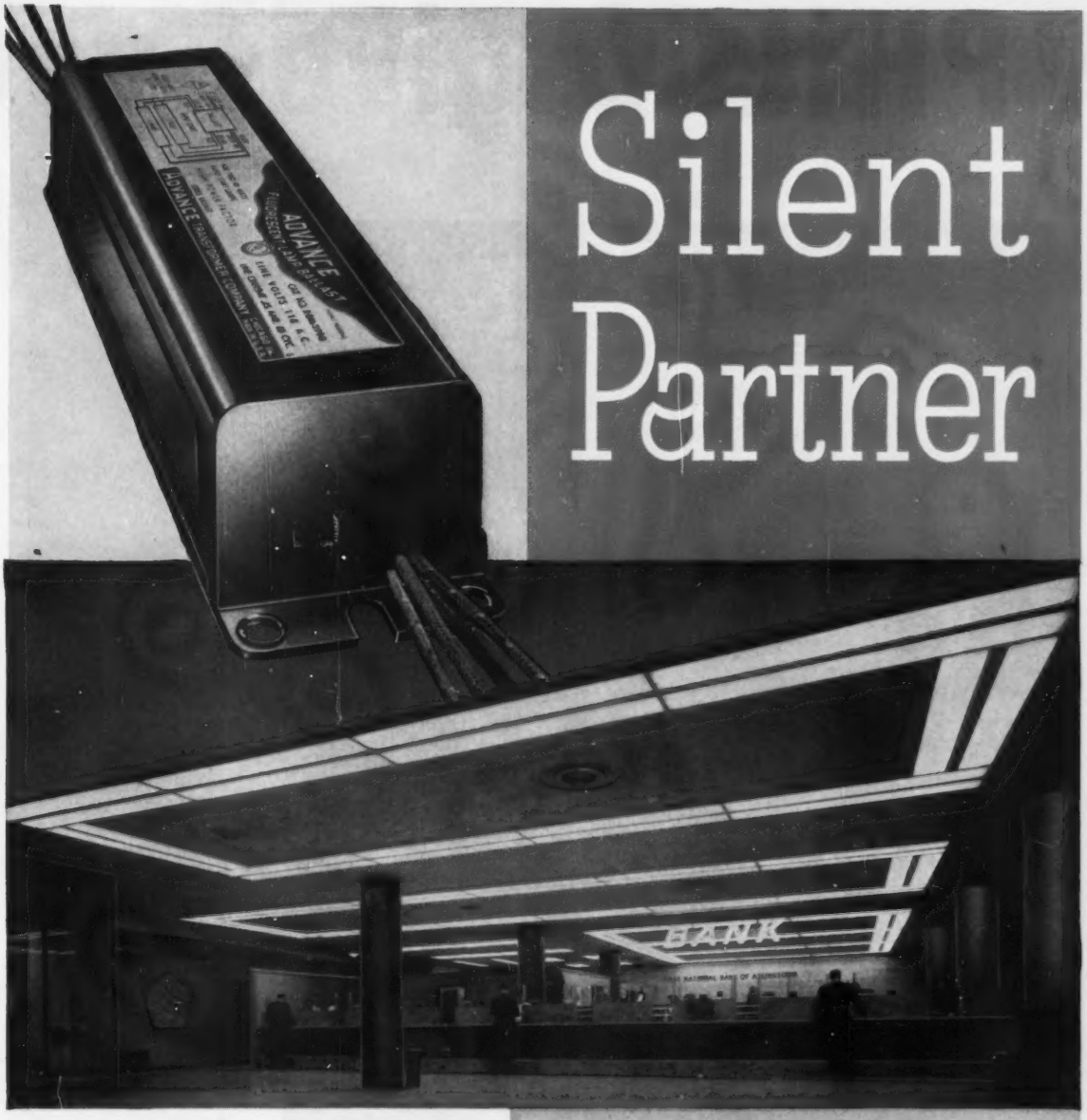
"We believe heavy Penta treatment gives our poles a service life of upwards of 30 years... even under severe conditions."

You can measure Penta protection. Penta is a uniform, never-varying chemical compound. Increment borings from Penta-treated poles can be chemically analyzed. Such analysis gives *positive proof* of Penta's protective staying power.

Cut maintenance costs by specifying Penta-treated poles, crossarms, transformer platforms, braces, control boxes and planking. For a list of over 85 dependable and cooperative treating plants—and your copy of the free booklet, "Poles and Crossarms"—write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, Dept. PI-4, St. Louis 1, Missouri.

MONSANTO

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU



Silent Partner

Fluorescent lighting equipment manufacturers know the performance of their product is judged by the dependability of its silent partner . . . the fluorescent lamp ballast. That's why ADVANCE is preferred by leading manufacturers like Lighting Products, Inc. of Highland Park, Illinois, who chose ADVANCE ballasts for their new "Thin-Lite" luminaire, shown in the above installation. The performance and dependability which ADVANCE fluorescent lamp ballasts provide have made ADVANCE the world's largest exclusive ballast manufacturer.

Whether you manufacture, specify, install, use or maintain fluorescent lighting, your job will be easier if you make ADVANCE fluorescent lamp ballasts your silent partner.

The Heart of the Lighting Industry

First National Bank of Arlington, Virginia (Branch). Lighting installation supervised by Earl C. Douglass, Chief Electrician, Pentagon Bldg., Washington, D. C.

ADVANCE

CBM CERTIFIED

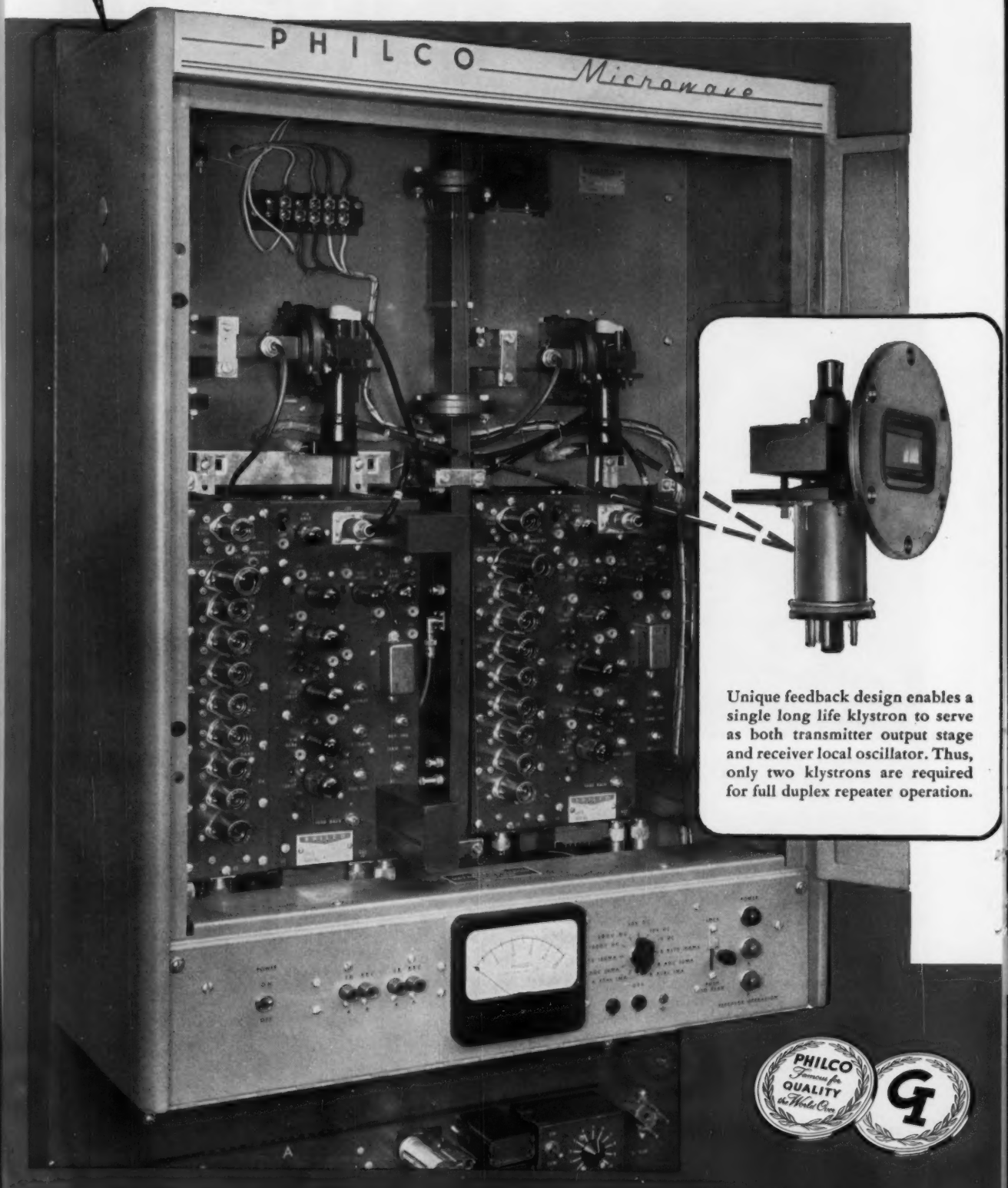
World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

TRANSFORMER CO.

2950 No. Western Ave. Chicago 18, Illinois

Let the ADVANCE nationwide network of service-stocking distributors be your partner too, in your ballast service needs. Write for complete details and name of distributor nearest you.

PHILCO gives you



Unique feedback design enables a single long life klystron to serve as both transmitter output stage and receiver local oscillator. Thus, only two klystrons are required for full duplex repeater operation.

PHILCO
Famous for
QUALITY
the World Over

GT

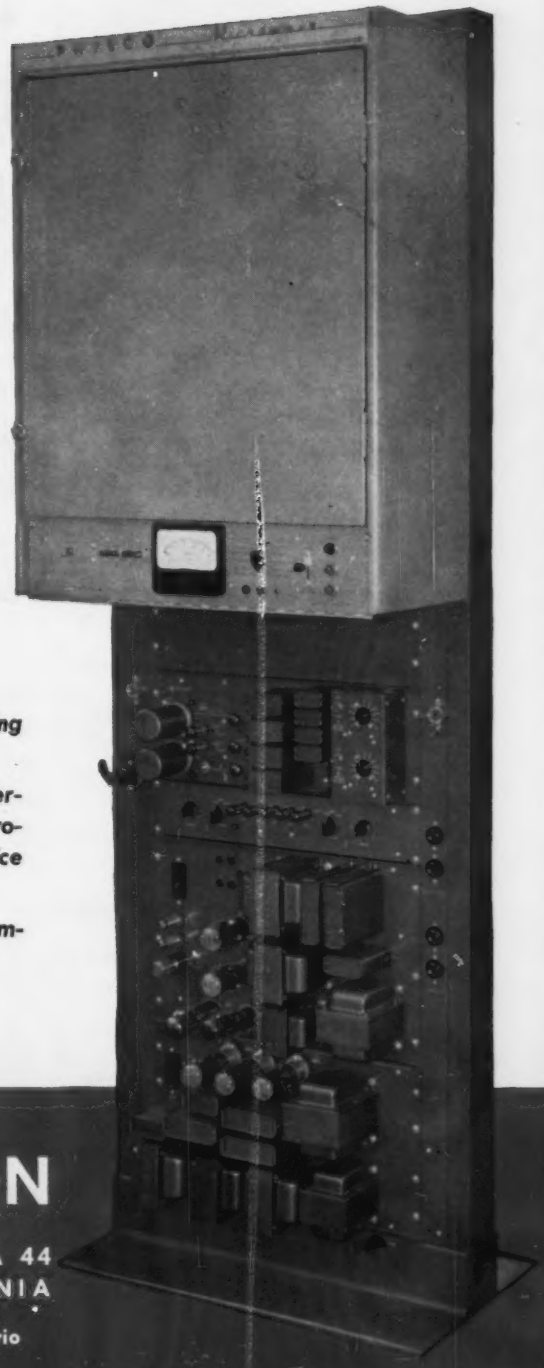
Ten Times More Microwave Power!

PHILCO'S "POWER HOUSE" klystron generates a full watt of power (10,000 watts Effective Radiated Power) in the preferred 6000-8000 mc band . . . provides up to 10db additional safety margin.

Designed specifically for reliable, long distance communications, Philco CLR-7 microwave systems provide high quality communications facilities that accommodate voice, telemetering, supervisory control, teletype, and other forms of data transmission so vital to operations.

Available as a terminal or repeater in Common Carrier, Industrial, and Government bands, Philco CLR-7 microwave provides a degree of reliability never before attained in microwave equipments.

Get complete information on Philco microwave systems. Philco maintains a staff of design, systems, and field engineers experienced and fully qualified to help plan and design your microwave communications system. Write Philco, Dept. EW today.



- ★ ***Designed for continuous unattended operation***
- ★ ***Base band available for telemetering and supervisory control . . . teletype***
- ★ ***Centralized system control from terminal stations***
- ★ ***Built in test and metering facilities***
- ★ ***Portable transistorized termination unit provides two-way signalling on service channel***
- ★ ***Conservatively rated components throughout***

PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44 PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario

Congratulations

to the winners of the George A. Hughes awards for 1955

Division A—Over 250,000 Meters

Electric Range Activity
TEXAS POWER & LIGHT COMPANY
DALLAS, TEXAS

Electric Water Heater Activity
OHIO POWER COMPANY
CANTON, OHIO

Commercial Electric Cooking Activity
GEORGIA POWER COMPANY
ATLANTA, GEORGIA

Division B—Under 250,000 Meters

Electric Range Activity
METROPOLITAN EDISON COMPANY
READING, PENNSYLVANIA

Electric Water Heater Activity
FLORIDA POWER CORPORATION
ST. PETERSBURG, FLORIDA

Commercial Electric Cooking Activity
KENTUCKY UTILITIES COMPANY
LEXINGTON, KENTUCKY

Hotpoint is happy to join the Electric Industry in congratulating these electric utility companies for their outstanding accomplishments in 1955.

Through their efforts in successfully promoting the use of major electrical appliances, they have earned the distinction of leadership. And, in so doing, they have brought greater comfort and convenience to their customers—through modern electrical living.

Hotpoint is proud to salute these progressive utility companies, and their employees—the winners of the George A. Hughes Awards for 1955.

Hotpoint

PLAN NOW TO ENTER THE 1956 COMPETITIONS
WATCH FOR DETAILS—TO BE ANNOUNCED SOON...

NOW **Watch for Your Guide to**

INCREASED UTILITY REVENUE...

Here is the up-to-the-minute key to increased revenue for promotion-minded utility companies, whether they are "merchandising" or not.

"Hotpoint Studies Women" is a plan-book that offers you *proved* methods of building load—through women-tested appeals to the day-by-day advantages of electrical living.

Your national trade promotions on the ease and convenience of better electrical living tell "why." Hotpoint's exciting and informative presentation tells you "*how*"!

You'll want to be sure to learn what the results are when "Hotpoint Studies Women." It's coming your way—*soon!*

LIVE BETTER ELECTRICALLY

Again, **Hotpoint** *looks at Tomorrow, Today!*

RANGES • REFRIGERATORS • AUTOMATIC WASHERS • CLOTHES DRYERS
DISHWASHERS • DISPOSALLS® • WATER HEATERS • FOOD
FREEZERS • AIR CONDITIONERS • CUSTOMLINE

HOTPOINT CO. *(A Division of General Electric Company) 5600 West Taylor Street, Chicago 44, Illinois*

FIRST TO BE MOLDED IN NEW HY-BUTE ⚡60* INSULATION

ACTUAL SIZE

G.E.'s New 15-kv Instrument Transformer Mounts Easily; Needs Less Maintenance

LIGHT AND MORE RUGGED, TYPE JKW-5 MOUNTS IN ANY POSITION

General Electric's discovery of an internal oxidation mechanism which can be added to ordinary butyl to prevent arc-tracking now makes feasible the molded construction of outdoor current transformers in the higher voltage ranges. This new compound, Hy-Bute/60 insulation, gives you seven big advantages in the new type JKW-5 15-kv instrument transformer.

NEW JKW-5 REPLACES 3 TRANSFORMERS because it can be mounted in any position. It supersedes the bottom, top and side-connected designs. This simplifies stocking and maintenance problems.

CORROSION-RESISTANT materials—new Hy-Bute/60 insulation, stainless steel and copper—virtually eliminate necessity for maintenance.

WEIGHS 20% LESS than older type, top connected transformer of the same rating.

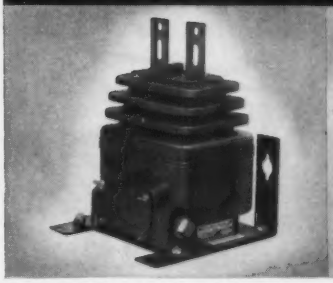
SMALLER SIZE coupled with lighter weight makes the General Electric JKW-5 easier to install. The new transformer, shown here in actual size, measures only 15¾ inches high, 10⅞ inches wide and 9½ inches long.

NO PORCELAIN BUSHINGS to crack because new Hy-Bute/60 serves as bushing, insulation and case on the new JKW-5. This feature removes possibility of failure which might occur as a result of thermal shock or external damage to porcelain bushings.

SAFER OPERATING, General Electric's Hy-Bute/60 insulated transformers cannot explode or catch on fire like older types.

LONGER LIFE is assured because Hy-Bute/60 insulation is mechanically tough, chemically inert, heat resistant, impervious to severe weather conditions and has high dielectric strength.

YOU GET SIMILAR BENEFITS IN OTHER MEMBERS OF G.E.'S BUTYL FAMILY



JKW-3 5-kv current transformer is available for outdoor applications

JKM-5 15-kv current transformer for indoor applications

JCP-0 600-volt current transformer for high-current indoor/outdoor applications

For more information about the new JKW-5, contact your nearest G-E Apparatus Sales Office or write for Bulletin GED-2727 to Section 581–2, General Electric Company, Schenectady 5, New York. For information about General Electric's complete line of instrument transformers, request Bulletin GEC-1028. 581-2

*Trade-mark of General Electric Co.

GENERAL ELECTRIC

LOOK FOR THE SIGN OF QUALITY

ALL ALONG THE LINE

IN YOUR UTILITY SYSTEM

MEES-40

MOLONEY ELECTRIC COMPANY

Power Transformers • Distribution Transformers • Load Tap Changing Transformers • Regulating Transformers • Step Voltage Regulators • Primary Unit Substations • Secondary Unit Substation Transformers • Network Transformers • Series Street Lighting Transformers • Subway Transformers • Industrial Dry Type Transformers • Capacitors • Magnetic Components for Electronics

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

ELECTRICAL BUSINESS OUTLOOK

Electrical World
MAY 28, 1956

Heavy power equipment manufacturers will be keeping a close check on the general tightening in materials procurement and lengthening delivery schedules reports the EEI Power Survey. The situation isn't critical yet but it could turn overnight. Most troublesome items—heavy steel plate and nickel bearing alloys.

Annual load factor of the nation's electric system will hit a high of 64.8% in 1958 and then drop slightly to 64.6% in 1959. This latest forecast of the EEI Power Survey means the '59 load factor will be 2.9% higher than 1954 (62.8%) and 1.6% higher than 1955.

December peak loads for the years 1956-1958 are higher than those forecast last October by EEI. The new peaks look like this: 1956—105.84 million kw (up 2%), 1957—114.1 million kw (up 2.8%), 1958—122.3 million kw (up 3.6%), and 1959—130.6 million kw. Detailed stories on pages 116 and 224.

• • •

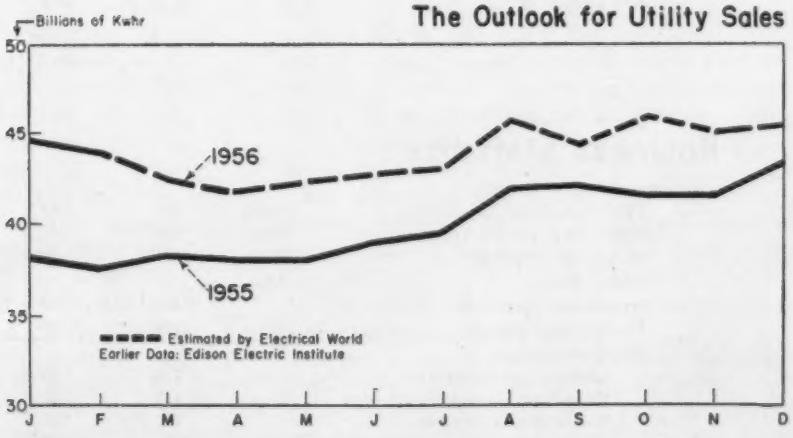
A 33% jump in industrial energy sales between 1955 and 1959 is a definite possibility. That's the impression you get reading between the lines of McGraw-Hill's latest survey of Business Plans for New Plants and Equipment.

Manufacturers plan to expand production capacity 26% on the basis of an expected 24% increase in sales over this period. Effectively, this means increasing production 24%. Looking back over the past five years you see industrial energy sales (less Atomic Energy Commission sales) going up roughly 1.25% for every 1% increase in manufacturing production. In terms of future industrial sales this adds up to a whopping 328.5 billion kwhr in 1959 (including AEC).

• • •

Wages and automobiles will play a big part in setting copper prices in the third and fourth quarters. Average copper prices have stabilized around 45½¢ per lb over the last couple of weeks. Increased copper production and a slight drop in consumer demand (said to be caused by drastic cutbacks in automobiles) have set up a delicate balance in supply and demand. A strike in the copper industry (present contracts expire June 30) and a sharp upturn in autos this fall with the advent of new models would destroy this balance. Chances are copper prices would then seek new highs.

The Outlook for Utility Sales



STATISTICS

Federal Power Jumped to 13% of Total U.S. Installed Capacity in 1955

(% of Total Installed Generating Capacity)

	Investor-Owned	Cooperatives	Municipal Plants	Other Public	Federal	Total Utility	Railway & Ind'l
1955 p	66.6	0.6	6.0	1.5	13.0	87.7	12.3
1954	66.6	0.6	6.1	1.6	11.4	86.3	13.7
1953	66.3	0.6	6.1	1.6	10.6	85.2	14.8
1952	66.1	0.5	6.2	1.7	10.0	84.5	15.5
1951	66.8	0.6	6.2	1.5	9.0	84.1	15.9
1950	66.6	0.4	6.4	1.5	8.3	83.2	16.8

Note: p – preliminary
Source: Edison Electric Institute

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Mar.	116.56	115.59	104.93	11.1
Peak—Class I Systems (million kw)	Feb.	94.2	95.8	83.8	12.4
Estimated Dec. '56 Peak (million kw)	Feb.	105.56	105.45	103.31	2.2
Production—billion kwhr	Mar.	50.34	47.99	44.45	13.3
Hydro		11.78	10.63	10.40	13.3
Fuel		38.56	37.36	34.05	13.2
Sales—billion kwhr	Jan.	46.32	45.19	39.47	17.4
Residential		13.41	12.25	11.76	14.0
Commercial		7.00	6.81	6.24	12.2
Industrial		23.57	23.75	19.31	22.1
Other		2.34	2.39	2.15	8.8
Fuel Consumption	Mar.				
Coal—million tons		13.39	13.44	11.51	16.3
Oil—million barrels		6.22	7.10	6.81	−8.7
Gas—billion cu ft		85.17	67.81	83.41	2.1
Net Income Class A & B Co's—$ million	Jan.	127.26	125.72	112.21	13.4
Residential Customers—millions	12 mos.	44.60	44.51	43.34	2.9
Revenue per kwhr	ended	2.63¢	2.64¢	2.68¢	−1.9
Avg kwhr per customer	Feb. 29	2,799	2,778	2,587	8.2
Avg annual bill		$73.67	$73.34	$69.33	6.3

Business Statistics . . .

Indexes: 1947—49=100					
FRB Industrial Production	April	143	143	138	3.6
ENR Construction Cost	May	144.4	143.2	137	5.4
BLS Cost-of-living	Mar.	114.7	114.6	114.3	0.4
NEMA Sales	Mar.				
Insulation materials		168	163	160	5.0
Electric appliances		120	109	117	2.6
Wholesale prices	Feb.				
Motors and generators		126.6	126.5	121.0	4.6
Transformers and regulators		131.2	131.2	127.8	2.7
Switchgear and fuses		147.5	147.5	135.4	8.9
GNP—annual rate—$ billion	1st. Qtr.	398.5	397.3	375.3	6.2

Your Business

Pleasure boating is estimated to attract about 25 million persons each year. You may be one of these. As such, you should be interested in following the necessary safety precautions.

Proper safety rules for small boat owners are readily obtainable. Local yacht or boating clubs and national associations can furnish them. Failing this, a number of useful and interesting booklets are obtainable from the U. S. Coast Guard, Treasury Department, Washington, D. C., or the Coast Guard Auxiliary.

The auxiliary has issued a series of brief, easily understood pamphlets titled: "Practical Course in Basic Seamanship and Safe Boating." Lesson eight (9 pages), for instance, deals with "Safe Motorboat Operation." Booklets available from the Coast Guard include: "Motorboats. Minimum Legal Requirements and Suggestions For Your Safety and Pleasure," and "Motorboat Safety."

There are many safety rules to observe in your own interests, and those of your passengers. They cannot all be listed here but these are some important ones:

1. Don't overload your boat.

2. Don't leave shore in a leaky or poorly constructed boat.

3. Liquor and safe boating don't mix.

4. Observe the pilot rules.

5. Instruct at least one of your passengers in the rudiments of handling your boat in case you should become disabled.

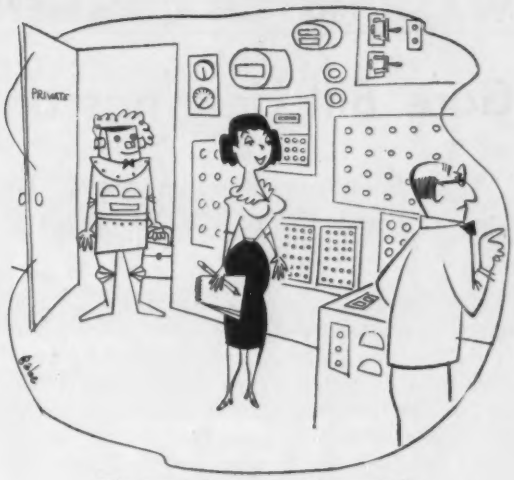
6. Do not venture into dangerous or restricted water.

7. Have life preservers readily available and wear them when conditions warrant.

8. Check your weather and tides before going out, and have due regard for them.

9. Be sure fuel tanks are vented and bilges free from oil, waste, grease, etc.

10. Be sure electrical equipment and wiring are in accordance with good marine practice.



"The man is here to fix the computer!"

Boating safety takes on greater significance this year in view of the possibility of federal investigation of the need for legislation to regulate pleasure boating. This may come because of the increasing number of fatalities each year.

Your Health, REX H. WILSON, MD, Medical Director, B. F. Goodrich Co

Most people like to think they are well-adjusted. Actually this is far from the truth. Everyone has his periods of frustration and worry. Pressure on the job, your way of living, even your family can upset your nervous system. If these emotional crises build up and continue for some time, they can cause trouble in one of the organs of the body.

Nervous tension can cause, among other things, increased stomach acidity, ulcers of the stomach, colitis and high blood pressure. Some "heart attacks" are attributed to a "high strung" nervous system.

If you are a "sensitive soul" you should avoid "pressure" situations. Of course you first have to admit that your nervous system is easily irritated. Many people seem to be afraid to admit that they just cannot take it.

Most cases of nervous tension and breakdown, except those resulting from illness, can be avoided. Nervous fatigue occurs just the same as physical fatigue. Everyone needs mental as well as physical rest and relaxation. A good book, an entertaining play or a good game of checkers are effective. A vacation should be a playful, relaxing time with all thoughts of the daily routines put aside.

The ability to experience fear, frustration, exasperation, and desire—in fact, the ability to think—can be harmful if nervous tension or an anxiety state is created. Ambitions, dreams, sorrows and cares can also aid in creating a well-rounded person if intelligent self-control is used.

Perhaps it is true that most of us take ourselves too seriously. Living our lives to the fullest each day and not worrying about tomorrow may make more tomorrows.

WASHINGTON COMMENT

Gore Bill Hearings on A-Power Open

Joint Committee on Atomic Energy discusses public-power-supported proposal that federal government build six nuclear power reactors

Hearings opened last week before the Joint Committee on Atomic Energy on the bill by Sen Albert Gore (D-Tenn.) proposing that the federal government build six nuclear power reactors. Two months ago the Gore bill, which has the support of federal power proponents in Congress, was a dead issue.

But Sen Gore and his supporters now claim that there is fresh evidence of need for the course they propose. They point to requests from utility industry spokesmen for federal insurance aid on nuclear power projects; for tax concessions; for exemption from the Public Utility Holding Co Act of 1935. These, on top of the government assistance being granted under the reactor demonstration program, they say, mean that the government is shouldering the major financial responsibility.

This being the case, the government might as well take on the entire project and retain full control. At the same time, they argue that private industry is dragging its feet and the U. S. is losing to the Russians and English the race to develop nuclear power.

"In the absence of action by the Congress we stand to lose the atomic power race," says Gore.

Sen Gore denies that his bill is an attempt to get the federal government into the nuclear power field. He insists that the public vs private power issue has no place in this matter. But at the same time he concedes that if the Atomic Energy Commission built the proposed six reactors, it would have to observe the preference clause contained in the Atomic Energy Act of 1954.

There are indications though, that Gore's bill will have unanimous Democratic support. In anticipation of the conviction the federal government will underwrite some form of liability insurance for nuclear power projects over and above the sum private insurers are willing to accept, there is hope that the private industry nuclear power program will forge ahead.

For instance, Joint Committee Chairman Sen Clinton P. Anderson (D-N. Mex.), has said that he would prefer not to see the Gore bill brought up at the present time. He has expressed the fear privately that if the government goes into the reactor business on a large scale it will tend to discourage private industry from going ahead.

Another joint committee member, Sen John O. Pastore (D-R.I.), while indicating no preference one way or the other on the Gore bill, seems to feel that with the question of insurance solved, there should be nothing to hold back the private industry program.

Washington observers believe that out of the Gore bill hearings these points might develop:

1. A determination that someone has to make a finding on whether or not the U. S. really is behind the Russians and English in nuclear power development.

2. What kind of program would be required to get us ahead if we are losing the race.

TECHNICAL NOTES

Conducting fluid can be pumped without moving parts by impressing transverse electric current on it perpendicular to a magnetic field.

Fault duty on a series capacitor applied to a distribution transformer approaches a maximum when the fault location makes the sum of line and transformer reactance equal to the capacitor reactance. Current for a solid fault then is limited only by circuit and transformer resistance.

Solar heating is predicted for 13 million U. S. homes by 1975.

Tapping all natural heat sources, an experimental residential heat pump will draw air from the roof which is 7-10F above ambient air and take 60,000 Btu per day of waste heat with coils in the septic tank which is warmed by enzyme action and wash water heated by the household water heater.

Laminated crossarms meet strength requirements of solid arms provided none but the center lamination has a splice near middle of the arm.

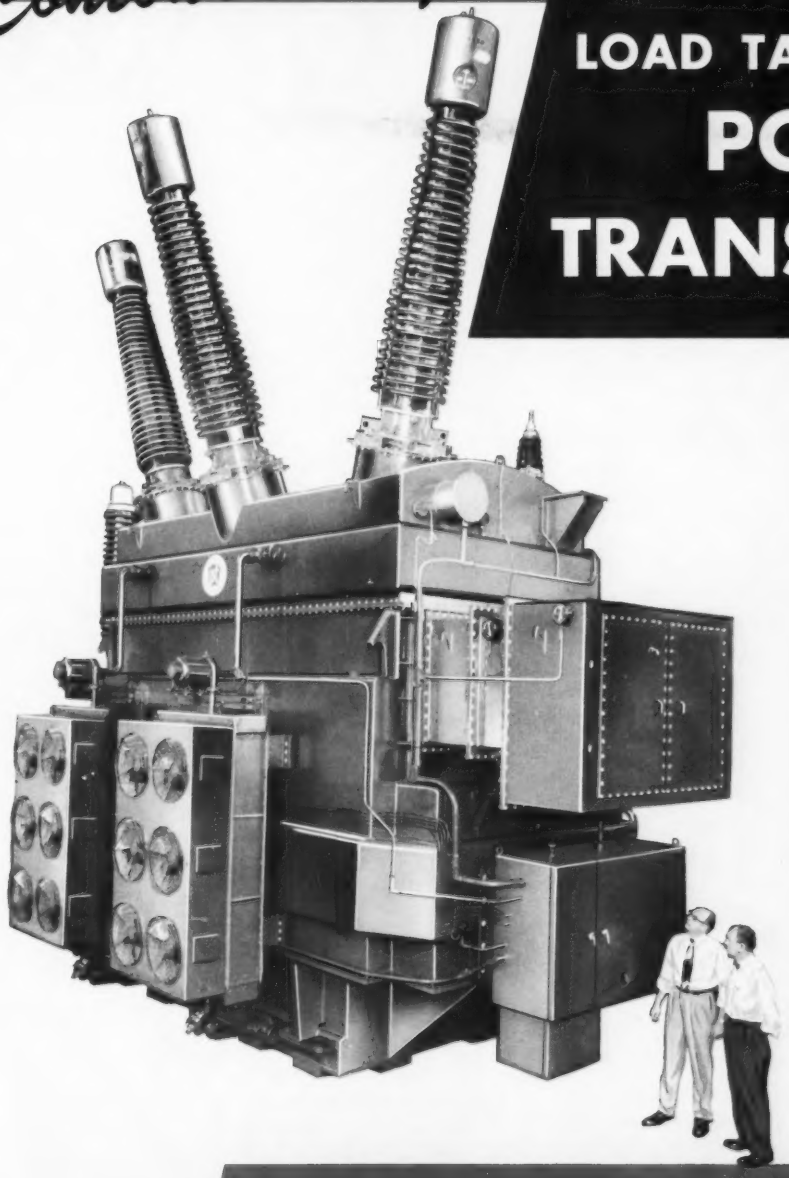
Electric drive for oil-well drilling cuts noise complaints, improves safety, and cleans up work site.

100,000 Kva, 330 Kv

THREE PHASE.....

Contour Design

PENNSYLVANIA LOAD TAP CHANGING POWER TRANSFORMER



The efficiency and compactness of Pennsylvania's shell-form Contour Design were "made to order" for this 100,000 kva, 330 kv transformer — one of the largest ever built from the standpoint of voltage. The unit will step down a transmission-line voltage of 330,000 volts to the 14,400 volts required for plant distribution. Its features include corona-free high-voltage coils with uniform impulse voltage distribution . . . and Pennsylvania's new high-capacity load tap changing equipment, designed for applications through 150,000 kva. The forced-oil cooling system has four oil-to-air heat exchangers.

pt

PENNSYLVANIA TRANSFORMER COMPANY

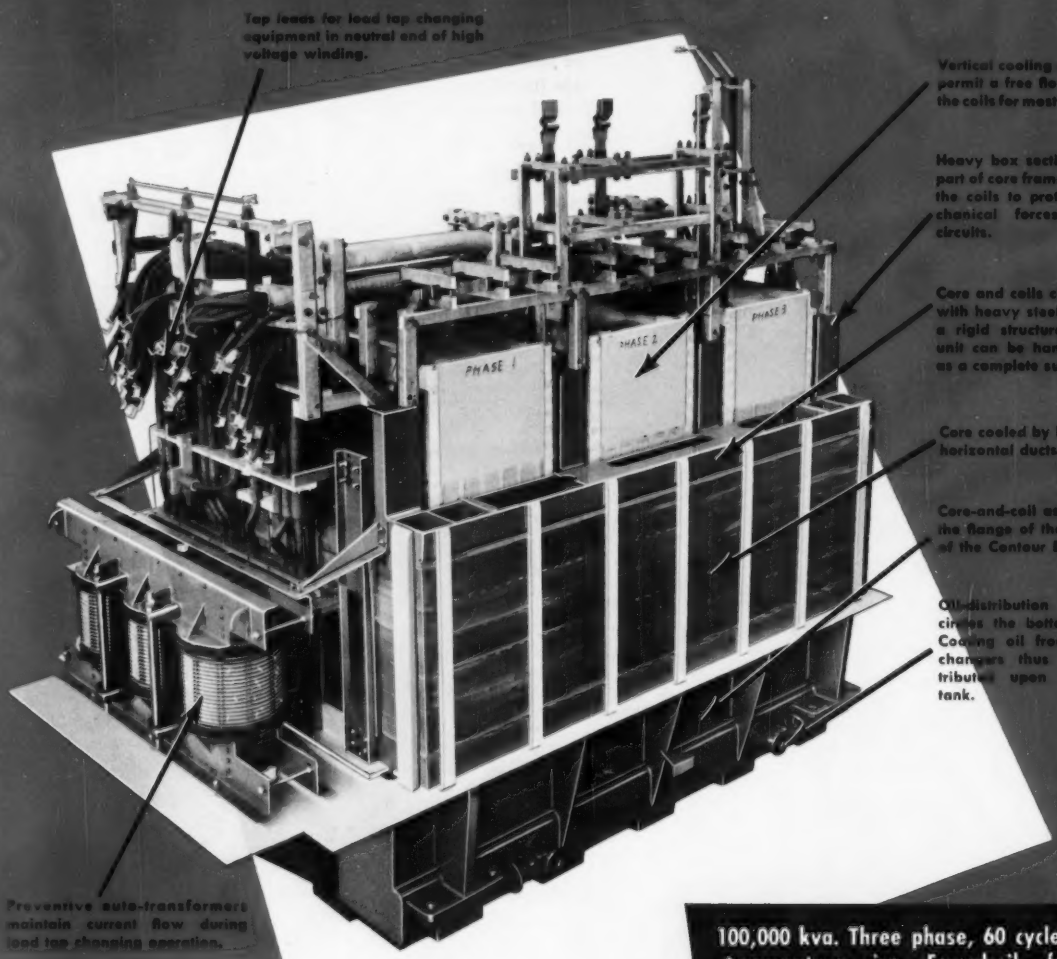
A McGraw Electric Company Division

CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

see next page for inside story

inside a
100,000 Kva, 330 Kv

THREE PHASE *Contour Design* PENNSYLVANIA LOAD TAP CHANGING
POWER TRANSFORMER



Tap leads for load tap changing equipment in neutral end of high voltage winding.

Vertical cooling ducts in the coils permit a free flow of oil through the coils for most efficient cooling.

Heavy box sections which form part of core frame securely clamp the coils to protect against mechanical forces during short circuits.

Core and coils clamped together with heavy steel frames to form a rigid structure. Core-and-coil unit can be handled separately as a complete sub-assembly.

Core cooled by both vertical and horizontal ducts.

Core-and-coil assembly rests on the flange of the bottom section of the Contour Design tank.

Oil-distribution duct completely circles the bottom of the tank. Cooling oil from the heat exchangers thus is evenly distributed upon re-entering the tank.

Preventive auto-transformers maintain current flow during load tap changing operation.

100,000 kva. Three phase, 60 cycles, 55° C. temperature rise. Forced-oil, forced-air cooled. High voltage: 330,000 Grd. Y volts. Low voltage: 14,400△ volts. Load tap changing equipment for ± 10% regulation in 32 steps of 5/8%.

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

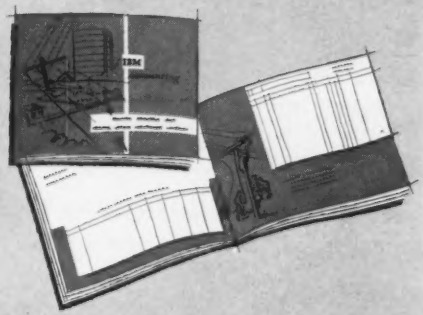
For external view, see other side.

A COST-FREE WAY TO DISCOVER

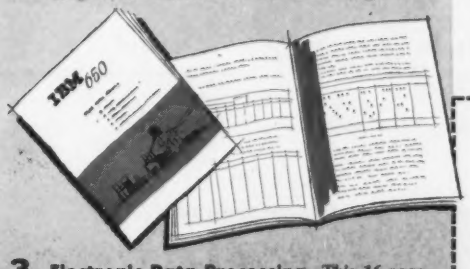
40 WAYS Public Utilities can get added profits from IBM Accounting

3 NEW GUIDES... FROM IBM

1. Customer Accounting. This 24-page booklet outlines the Customer Accounting procedure from initial application for service to accounts receivable statements.



2. General Accounting. This 44-page booklet is a guide to the IBM punched card documents and the machine reports you can get in such fields as: Property Accounting, Construction Accounting, Payroll (including check preparation and payroll tax reports), Operating Ledgers, and Electronic Data Processing.



3. Electronic Data Processing. This 16-page booklet describes the application of the IBM 650 to Customer Accounting operations, including an IBM 650 schematic program for Bill Calculation and Statistics.

Here are 40 opportunities for improving Public Utility accounting through IBM data processing. Several of these applications are actually by-products of other jobs. Many of them can be accomplished on present equipment . . . in *addition* to your current applications.

Now is the time to determine whether *your* machine accounting system is adequate for the increasing demands on your company. For today, new machines and improved applications hold the answer to a broader and even *more* profitable use of IBM methods.

The three folders offered here tell the complete story. With them you can decide for yourself *exactly* how and where you can start cutting costs . . . and giving even better customer service.

Send for your copies today—without obligation, of course.

Check list of 40 IBM data processing applications for electric, gas and water utilities

Use this list for a quick review of current applications. If you want to get even more from present equipment, or need further information on a *particular* application, just check off your area of interest . . . and send this list in with your coupon.

___Customer Billing
___Revenue Accounting
___Sales Analyses
___Rate Studies
___Government Tax Reports
___Merchandise Billing
___Merchandise Accounting
___Customer Accounts Receivable
___Accounts Receivable Control
___Collection Records
___Security Deposit Records
___Market Surveys
___Meter Control Records
___Meter Test Records
___Payroll Accounting
___Pay Checks and Earnings Records
___Pension Records
___Wage Studies
___Personnel Statistics
___Accident Records
___Savings and Loan Accounting
___Stores Accounting
___Physical Inventory
___Purchase Analyses
___Fuel Records
___Transportation Accounting
___Accounts Payable Accounting
___Expense Distribution
___Budget Reports
___Operating Reports
___Financial Reports
___Functional or Responsibility Accounting
___Insurance Records
___Engineering Studies
___Construction and Retirement Accounting
___Continuing Property Records
___Operating Ledgers
___General Ledgers
___Stockholders Records
___Dividend Checks and Proxies

IBM DATA PROCESSING

- DATA PROCESSING
- ELECTRIC TYPEWRITERS
- TIME EQUIPMENT
- MILITARY PRODUCTS

PUBLIC UTILITIES DEPARTMENT A56
International Business Machines Corporation
590 Madison Avenue, New York 22, N. Y.

Please send my FREE copy of:

☐ IBM Customer Accounting ☐ IBM General Accounting
☐ IBM 650 Electronic Data Processing

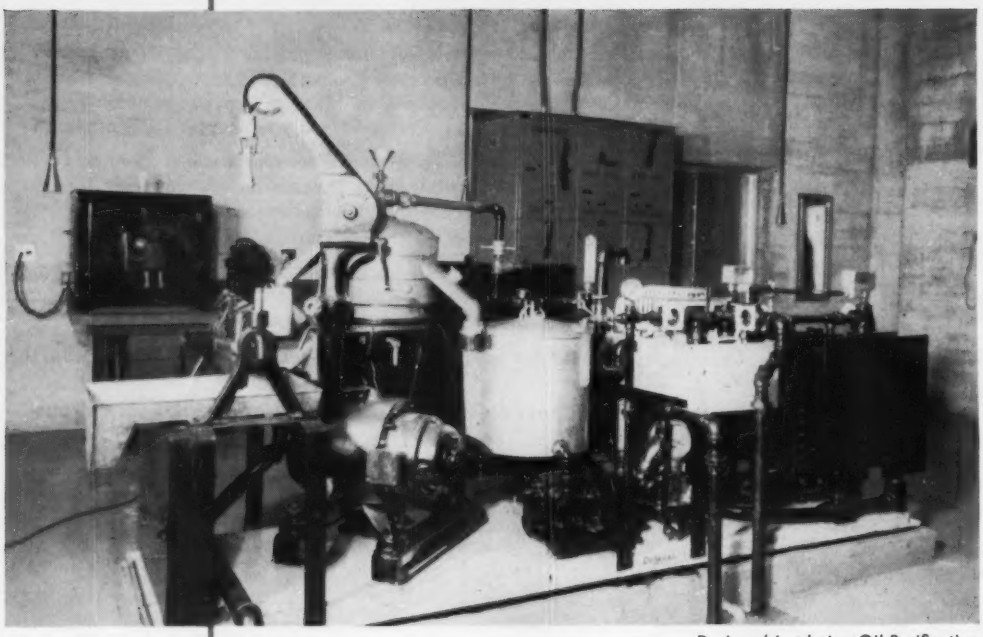
Name_____

Company_____

Street_____

City_____ Zone_____ State_____

H_2O vs. HIGH KV



De Laval Insulating Oil Purification Installation in a Large Hydro-Electric Plant

Moisture and high dielectric strength are incompatible in transformer and circuit-breaker oil. Even very little free water is too much.

That's why the majority of America's important power companies give the job of insulating oil maintenance to De Laval Purifiers.

No other equipment keeps oil so dry . . . at such low cost . . . so dependably.

De Laval Bulletin TR tells all. Write for it . . . today!

DE LAVAL
insulating oil purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • **DE LAVAL PACIFIC CO.** 201 E. Millbrae Ave., Millbrae, Calif.

LOWER COSTS per installed kvar

with Sangamo's NEW 50 kvar Diaclor Capacitor

Better weight distribution in less space enables more Kvar per pole. You get lower installed costs per Kvar for capacitor banks through more economical use of poles, racks, installation materials and time. Savings in switching and protective equipment are also realized.

The coupon below will bring you Bulletin 1121 with complete specifications on Sangamo's 25 and 50 Kvar Capacitors.

New, multi-petticoat solder-sealed bushings make a strong and permanent hermetic seal. Pressure compensating stainless steel lock washers and tin-plated terminal parts facilitate quick and permanent connections with either copper or aluminum conductors.

SANGAMO

SANGAMO ELECTRIC CO.

SPRINGFIELD, ILLINOIS

Please send your new Bulletin 1121 ☐. Also send Bulletin 1120, with the full Sangamo Power Capacitor story ☐.

NAME_____

COMPANY_____

POSITION_____

ADDRESS_____

CITY_____ STATE_____

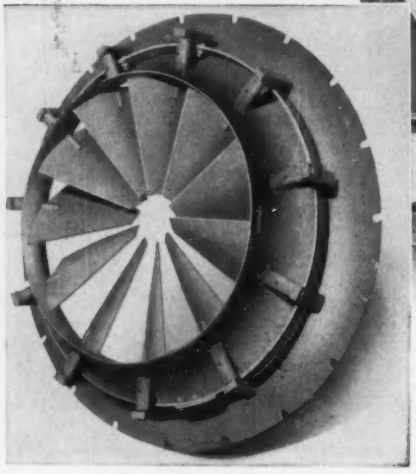
PC56-3

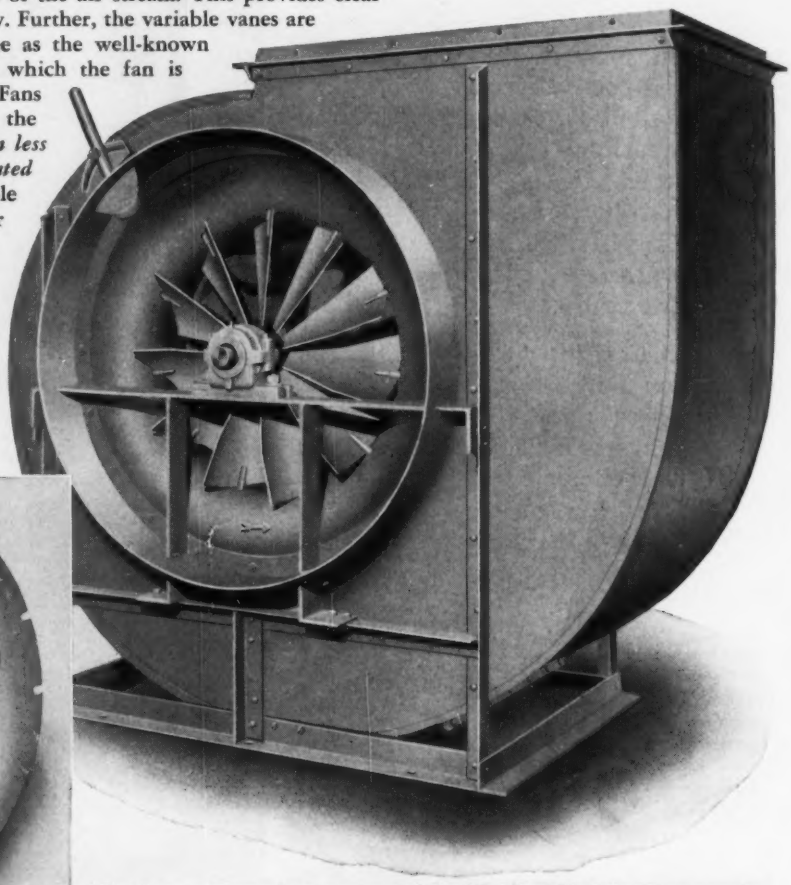
NOW! "BUFFALO" VARIABLE INLET DRAFT CONTROL

— WITH FIXED VANE PERFORMANCE AT WIDE OPEN POSITION

The variable inlet vanes of this "Buffalo" Forced Draft Fan are cantilevered into the fan's inlet shroud, with the operating linkage behind the shroud and entirely out of the air stream. This provides clear and unobstructed air flow. Further, the variable vanes are curved to the same degree as the well-known "Buffalo" fixed vanes, for which the fan is designed. Because "Buffalo" Fans are designed for fixed vanes the use of variable vanes *results in less than one percent reduction in rated capacity*. Construction is accessible and trouble-free. The entire lever and control ring assembly is permanently aligned for smooth operation with no backlash.

Here is one more illustration of the "Q" Factor* of performance and satisfaction that is yours when you specify "Buffalo" for mechanical draft.





Note how cantilevered arrangement of "Buffalo" Variable Inlet Vanes permits unobstructed air flow. Write for Bulletin F-1510 for full details on this smooth draft control with high performance.

The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

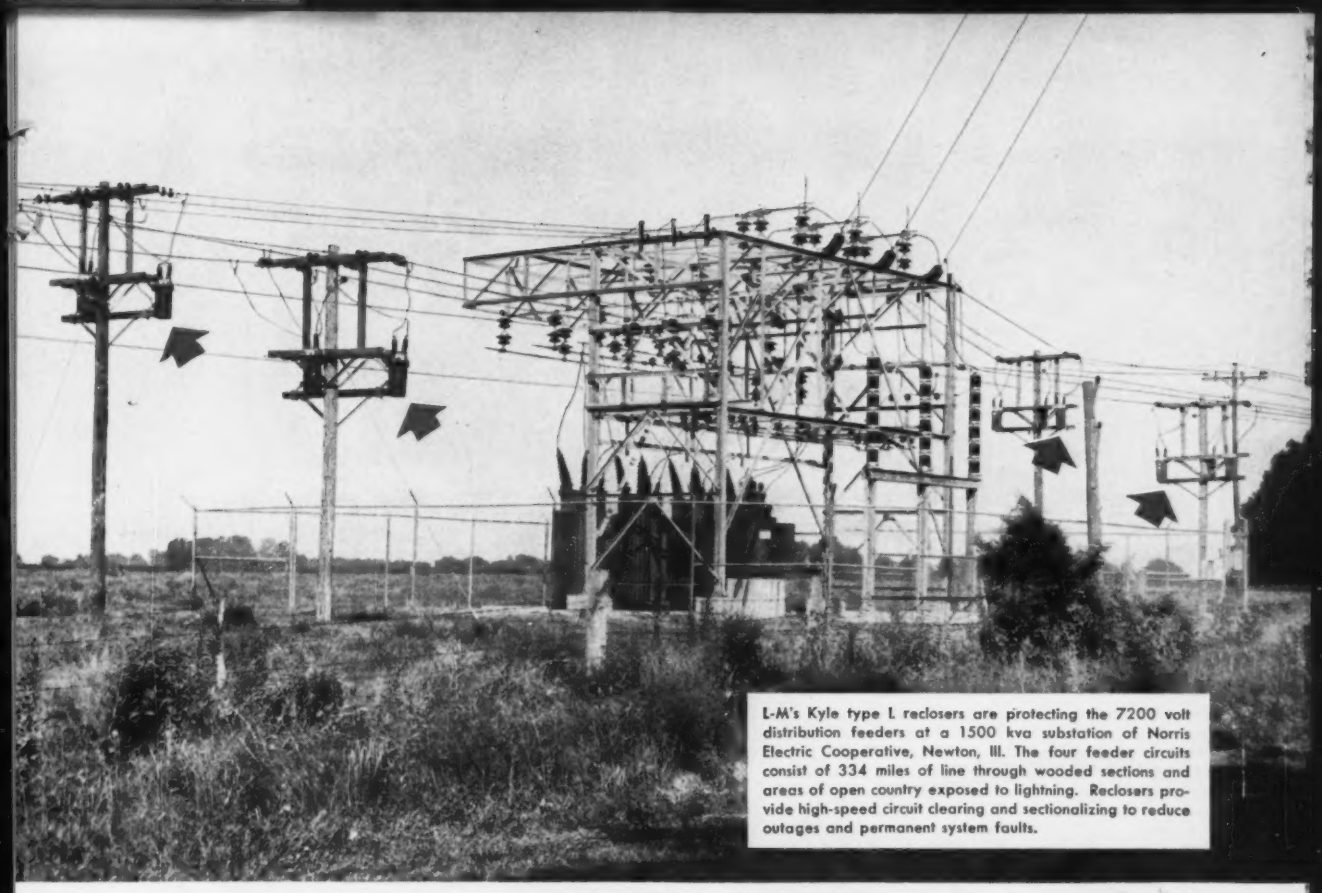
"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING



L-M's Kyle type L reclosers are protecting the 7200 volt distribution feeders at a 1500 kva substation of Norris Electric Cooperative, Newton, Ill. The four feeder circuits consist of 334 miles of line through wooded sections and areas of open country exposed to lightning. Reclosers provide high-speed circuit clearing and sectionalizing to reduce outages and permanent system faults.

Pole-Mounted Kyle Reclosers Serve As Automatic Disconnecting Device

L-M Kyle reclosers provide high-speed circuit clearing of feeders for transient fault protection and automatic disconnecting of permanent faults with minimum substation investment.

By **JOHN A. SCHWENKE**
Field Engineer
Springfield, Ill., Office
Line Material Company

The relatively high cost of circuit breakers and associated substation equipment has been eliminated at the Dieterich substation of the Norris Electric Cooperative, Newton, Ill. Kyle type L reclosers have been installed on the four 7200 volt distribution circuits to serve as the disconnecting device. These reclosers are completely self-contained and fully automatic.

In addition to segregating permanent faults from the system, L-M's Kyle reclosers provide the high-speed circuit clearing (2-cycles maximum) required to reduce conductor burndown resulting from transient or non-persistent causes.

Reduce Permanent Faults

Transient fault protection is available through coordinated operation of the substation recloser with reclosers and sectionalizing fuses on the feeders. It is possible to clear up to 90 percent of transient faults, reduce permanent faults, and secure these outstanding advantages with L-M reclosers:

- Less serious damage to conductors and equipment.
- Confining of trouble to small area.
- Increase revenue because outages are reduced.
- Greater service continuity.
- Aid in maintaining good public relations.

Kyle reclosers offer the widest choice of time-current characteristic curves and operating sequences. And only L-M offers the fully coordinated series of reclosers and sectionalizers that permits complete automatic protection.

Get the Whole Story on L-M's Kyle Reclosers and Sectionalizers

Ask your L-M Field Engineer for information and bulletins on Kyle apparatus and complete coordination—single- and three-phase—from substation to load. Or write Line Material Company, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

255

LINE MATERIAL Kyle® Reclosers

A McGRAW ELECTRIC COMPANY DIVISION

L-M's secondary capacitors are small, light, and very easy to install.

L-M Secondary Capacitors Improve Overloaded Distribution System

L-M offers complete line of secondary capacitors as an economical means to increase load capacity, reduce load losses, and improve voltage level of secondary system.

By **N. K. DELANEY**
Product Manager
Capacitors and Regulators
Line Material Company

The effectiveness and economic worth of secondary capacitors have increased considerably because of the heavy load growth from motored appliances. Many residential secondary systems have been forced to operate with loads having as low as 70-percent power factor.

Advantages of Secondary Capacitors

By improving the power factor in the secondary circuit, secondary capacitors can provide the same benefits as obtained by installing larger distribution transformers, heavier secondary conductors, or voltage regulators, and can do this at appreciably less handling and installation costs. This comparison, of course, must be within the range obtainable by power factor correction.

Transformer Capacity Increased

The maximum benefit from secondary capacitors is obtained at the most advantageous period, which is during peak-load conditions. The chart, Fig. 1, shows the decrease in transformer loading obtained by adding capacitors to the transformer secondary, and Fig. 2 shows the recommended number of capacitor units with various transformer ratings.

Load-Loss Reduction

The combination of transformer and secondary capacitor is more efficient than a transformer large enough to carry the load. The secondary capacitor, by increasing the power factor of the load, reduces the amount of current that has to flow through the transformer and secondary conductors.

Voltage Improvement

The value of voltage improvement with secondary capacitors is equal to the same amount of fixed primary kvar, *plus* the voltage rise through the distribution transformer and affected secondary.

LM
LINE MATERIAL
A McGRAW ELECTRIC COMPANY DIVISION

L-M secondary capacitors are available in 7½, 5, and 3 kvar. See chart for height and weight.

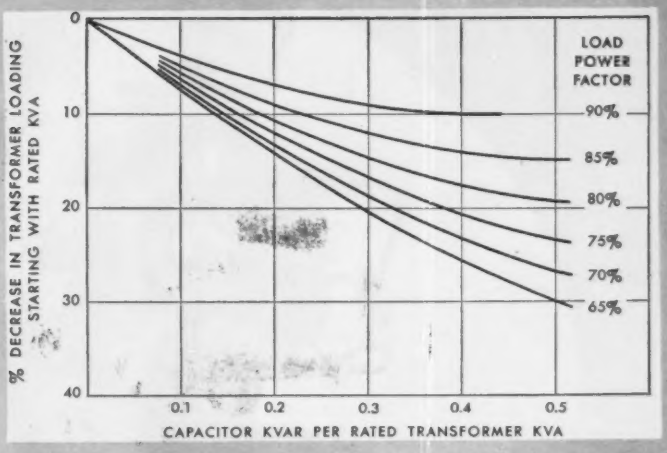
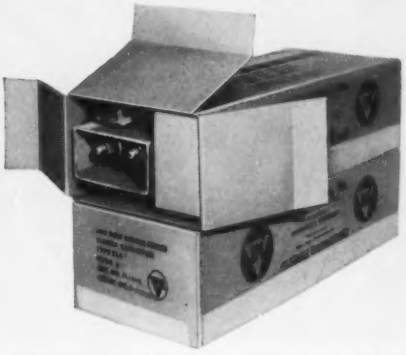


FIG. 1—These curves show how you can decrease transformer loading—at various power factors—by adding secondary capacitors.



L-M's unique carton permits easy testing of capacitors without removing them from the carton.

Distribution Transformer Rating in KVA	Recommended Number of Capacitor Units			
	3 KVAR	5 KVAR	7½ KVAR	10 KVAR
10	1	—	—	—
15	2	1	—	—
25	3	2	1	1
37½	4	3	2	1
50	6	4	2	2
75	9	5	3	3

FIG. 2—The above chart shows the recommended number of secondary capacitor units with various transformer ratings.

Capacitor Location

To obtain the maximum benefit, capacitors should be installed in pairs, located from ⅓ to ¾ the distance to the end of the secondary, in each direction. This recommendation is based on a reasonably uniform load distribution and secondary conductors in two directions from the transformer.

L-M Offers Complete Line Of Capacitor Equipments

L-M's secondary pole-mounted capacitors are available in 3, 5, and 7½ kvar. 10 kvar unit will be available soon.

L-M's 216-volt, 13⅓ kvar submersible capacitors are available in 40, 80, and 120 kvar racks, completely assembled at the factory ready for field installation.

L-M's complete line of primary capacitor equipments includes pole-mounted, single and multi-row racks, factory-assembled blocks and metal-enclosed equipments. Most capacitor equipments are available in 2400- to 13,800-volt; 25 or 50 kvar capacitor units.

Some Outstanding Features Of L-M's Pole-Mounted Secondary Capacitors

Leads of 48-inch, 600-volt wire furnished as standard equipment.

Bushing-Mounted Indicating Fuse with 48-inch lead can be supplied.

Solder-Sealed Bushings of strong one-piece wet-process porcelain provide a positive, lasting seal.

Pole-Mounting Bracket has two 9/16″ holes for ½″ lag screws. Standard EEI-NEMA crossarm-mounting bracket furnished if required. Capacitor can be mounted with bushings up or down.

Aluminum Metallizing process protects steel tank from oxidation; is followed by a chromate primer and a finish coat of alkyd resin paint.

Round-Pack, Round-Tank Design makes these capacitors small, light, easy to install. Unit has a one-minute discharge resistor; is completely impregnated under vacuum with low temperature Elemex liquid dielectric.

Weight and height of L-M's 240-volt, pole-mounted secondary capacitors.

Size Kvar	Height Inches	Net Weight* Pounds
3	13¾	18
5	18⅝	25
7½	23½	33
10	Available Soon	

*Weights include the pole-mounted brackets.

Get The Whole Story On L-M's Capacitor Equipments

Ask the L-M Field Engineer for complete information and bulletins on the construction and application of L-M's full line of primary and secondary capacitor equipments. Also on L-M's capacitor bank engineering service. Or write Line Material Company, Milwaukee 1, Wisconsin.

257

Elemex® Capacitors

Racks are designed for a minimum space requirement and can be passed through a 30"-diameter manhole.

Submersible equipments...

L-M's New Secondary Network Capacitors Increase Capacity, Improve Voltage

Line Material's new 216 volt, 13⅓ kvar submersible capacitor equipments can be your answer to heavier network loading. Secondary capacitors will improve the low power factor of heavy motor loads, such as air conditioning. This substantially reduces loading on conductors and transformers, and helps to improve low voltage conditions. Capacitor units can be installed more quickly and at much less cost than system changes, such as larger transformers, cables and additional vaults.

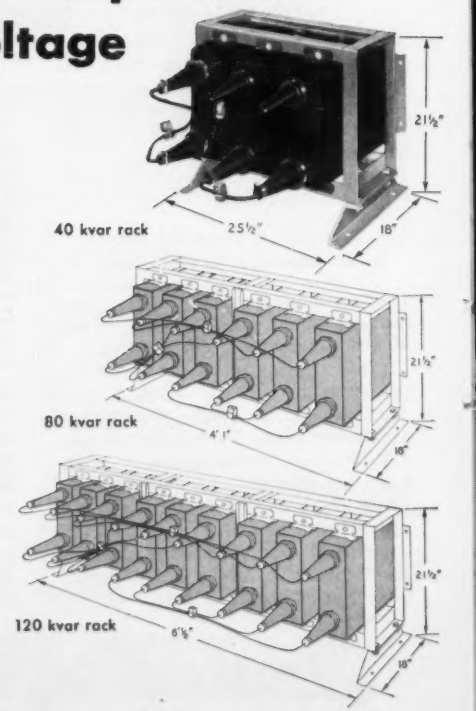
L-M's new secondary capacitors have outstanding product features such as aluminum metallic coating under a primer and finish coat of alkyd resin paint, strong solder-sealed bushings, and low-temperature Elemex liquid dielectric. Each unit is equipped with one terminal mounted current limiting fuse; bushings are enclosed in water-tigh covers.

Capacitor Racks

Capacitor units are available in 40, 80, and 120 kvar racks, entirely assembled at the factory and ready for installation in the field. Racks can be stacked or mounted on floor, wall, or ceiling in many arrangements to fit vault space. Ambient temperature limits are 55° C. for single-tier equipments and 40° C. for two- or three-tier equipments.

Get Complete Information

Ask the L-M Field Engineer for information on features, design, and delivery on L-M's new secondary network capacitors and capacitor equipments. Or write Line Material Company, Milwaukee 1, Wisconsin



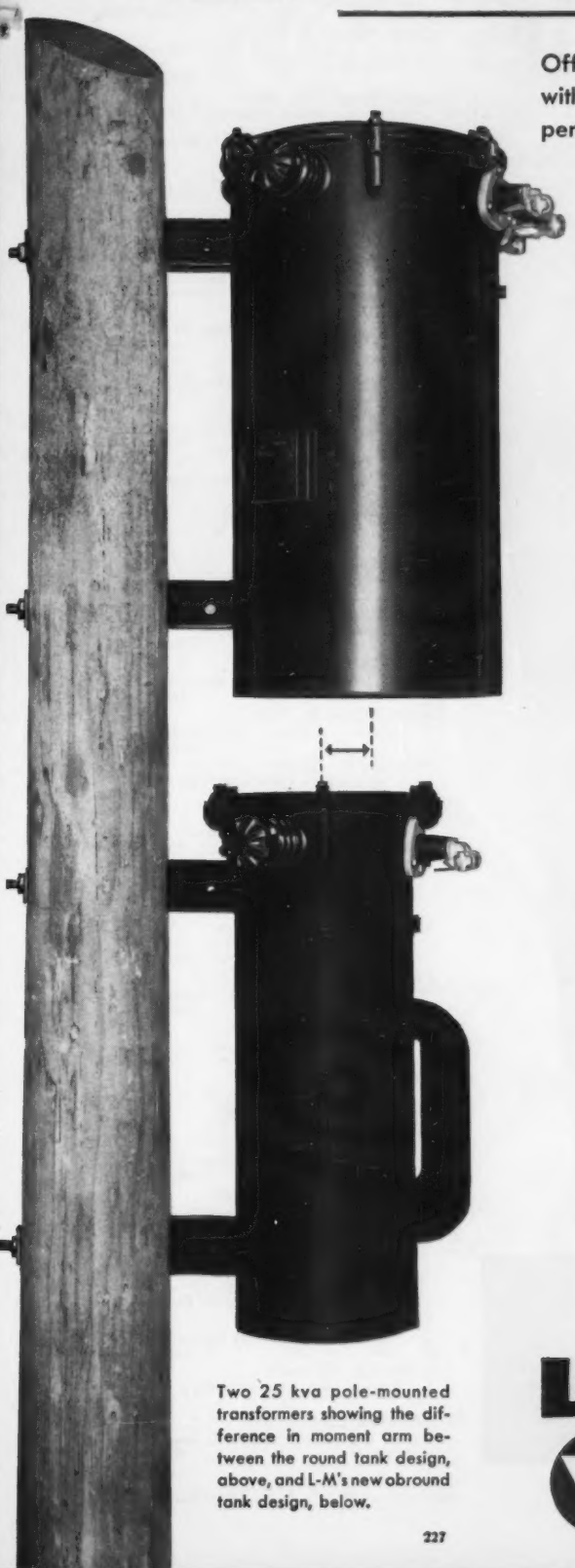
LINE MATERIAL

A McGRAW ELECTRIC COMPANY DIVISION

Elemex® Capacitors

247

How L-M's New Obround Design Provides 27% Less Bending Moment



Two 25 kva pole-mounted transformers showing the difference in moment arm between the round tank design, above, and L-M's new obround tank design, below.

Offers 33⅓% increase in transformer capacity on a pole, with no sacrifice of L-M's outstanding Round-Wound® performance characteristics.

L-M's new obround tank design is smaller, lighter, and has a shorter moment arm on the pole. The total bending moment is substantially reduced. Thus the potential capacity of all your transformer structures is greatly increased. L-M's new obround tank design retains all the outstanding Round-Wound performance characteristics.

Less Weight, Shorter Moment Arm

The new obround design has a smaller tank with less transformer oil, resulting in a lighter, easier-to-handle transformer. Cooling tubes are installed where required to provide adequate cooling surface. Transfer of heat from copper to outside air is faster and more efficient because of reduced mass.

The new obround design also reduces the moment arm distance from the pole. The combination of less weight and shorter moment arm distance greatly reduces the total bending moment on the pole.

COMPARE 50 kva *round* tank design and L-M's new 50 kva *obround* tank design:

50 kva ROUND tank design:
Moment arm from center of pole.....1.6 ft.
Weight.....860 lbs.
Bending moment 860 x 1.6.....**1,376 ft.-lbs.**

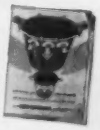
50 kva L-M OBROUND tank design:
Moment arm from center of pole.....1.33 ft.
Weight.....760 lbs.
Bending moment 760 x 1.33.....**1,010 ft.-lbs.**

L-M's new 50 kva *obround* transformer puts *27%* less bending moment on the pole than the 50 kva *round* tank design. That means that you put less strain on your structures—or you can now hang three 50 kva's where you formerly hung three 37½'s—a 33⅓% increase in capacity.

Round-Wound Performance

The advantages of less weight and shorter moment arm were accomplished without changing L-M's outstanding Round-Wound performance characteristics. These characteristics include low exciting current, high impulse strength, high short-circuit strength, and high short-time overload capacity.

Get Details on L-M's Obround Transformer



Ask the L-M Field Engineer for application information, weights and dimensions on L-M obround transformers and the exclusive Round-Wound design. Or write A. B. Coyle, Product Manager, Line Material Company, Transformer Division, Zanesville, Ohio (a McGraw Electric Company Division).

LINE MATERIAL

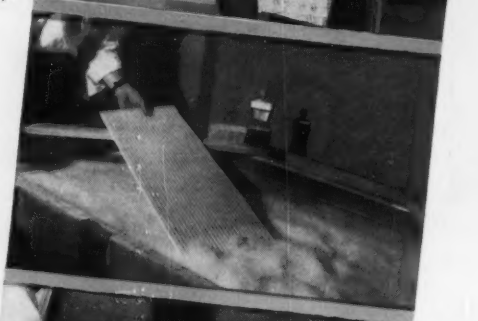
LM® Transformers

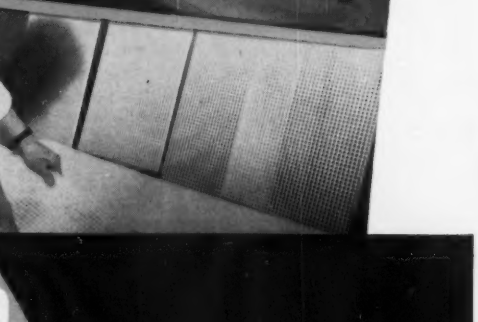
GrateLite*

LOUVER—DIFFUSER

COMES CLEAN QUICK

a two-minute operation





1. AN EASY ONE MAN JOB
2. JUST DUNK IN DETERGENT-WATER MIX
3. SWISH IT AROUND
4. SET IT UP TO DRY—THAT'S ALL

GrateLite regains its brand-new lustre every time—is automatically de-staticized by the detergent—and stays clean longer: bugs and dust drop through the openings—can't collect.

PLUS

High efficiency
Low brightness
Fine diffusion
Excellent shielding
Noise reduction
Air-conditioning diffusion

. . . the secret's in the sight-saving cubes and only GrateLite has them!

Write for free booklet **"The GrateLite Story"** *today.*

*® U. S. Pat. No. 2,745,001. Can. Pat. Pend.

Guth

THE EDWIN F. GUTH CO. • ST. LOUIS 3, MO.

Leaders in Lighting Since 1902

ADVERTISEMENT

ALABAMA, Birmingham
James R. Fuller • 3821 So. Cove Drive
Tremont 1-3046

ARIZONA, Phoenix
J. A. Ware, Jr. • 717 Buchanan St.
Alpine 2-9388

CALIFORNIA, Los Angeles
W. D. Evans, Jr. • c/o Pacific Industries
8255 Beverly Blvd.
Webster 3-0355

CALIFORNIA, San Diego
John Allen Ware & Associates • 301 W. "G" St.
Belmont 2-8578

CALIFORNIA, San Francisco
Dan H. Radke • 754 Natoma St.
Hemlock 1-5563

COLORADO, Denver
Gaer Sales • 1246 Galapago St.
Alpine 5-7310

FLORIDA, Jacksonville
Lester J. Hartman • 4911 Apache Ave.
Evergreen 8-2841

GEORGIA, Atlanta
Kennon & Johnson • 7 Camden Rd. N. E.
Atwood 5566

ILLINOIS, Chicago
Louis Licastro • 80 E. Jackson St.
Harrison 7-3454

INDIANA, Indianapolis
George E. Ransford • 2871 Corvallis Crescent
Belmont 8423

IOWA, Des Moines
Jack C. Ramsay • 4508 Urbandale
7-4661

LOUISIANA, New Orleans
H. S. Gregory • 820 Julia St.
Tulane 5207

MARYLAND, Baltimore
Douty & Downie • 2323 Maryland Ave.
Tuxedo 9-3470

MASSACHUSETTS, Winthrop
Rene Moisson • 27 Siren St.
Ocean 3-4064

MICHIGAN, Dearborn
C. C. Munroe, Jr. • 25741 Kennedy Drive
Logan 1-8713

MINNESOTA, St. Paul
Herman F. Strehlow • 1598 Berkeley Ave.
Midway 9-5914

MISSISSIPPI, Jackson
T. M. Salisbury • 429 South West St.
5-8305

MISSOURI, St. Louis
Paul J. Wiesler • 4545 McPherson Ave.
Forest 1-0838

MONTANA, Butte
T. D. McGarry • c/o Monitor Distributors, Inc.
604 Utah
8918

NEW YORK, Canandaigua
H. W. Lane • P. O. Box 166
Canandaigua 1001M

NORTH CAROLINA, Charlotte
E. N. Maddox, Jr. • 4308 Waterbury Drive
Franklin 5-7393

OHIO, Cincinnati
Tom Marshall • 327 Compton Hills Dr.
Webster 1-2138 or 1-4540

OHIO, Cleveland
Gordon F. Stofer & Bro. • 707 St. Clair Ave., N. E.
SU 1-3535

PENNSYLVANIA, Springfield
Roy B. Delany, Jr. • 436 Stanfield Rd.
Kingswood 4-0500

PENNSYLVANIA, Pittsburgh
V. E. Hendrickson • 4412 Liberty Ave.
Museum 1-9333

TEXAS, Dallas
Eugene C. Woodall • Room 309-Meadows Bldg.
North Central Expressway
Fortune 8-7197

TEXAS, Houston
Walter L. Clinton • 3735 Underwood St.
Capitol 3-4441

VIRGINIA, Richmond
Harris Turner • 1301 Ware Rd.
88-0761

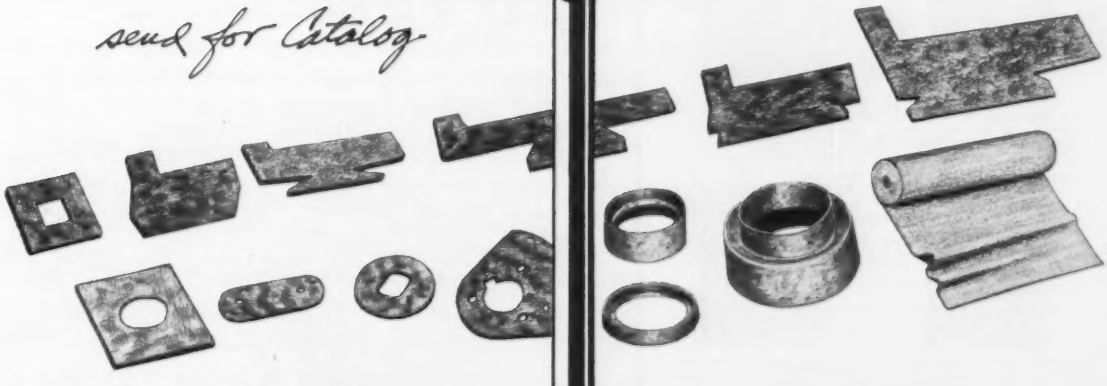
WASHINGTON, Seattle
W. A. Crowder • 1800 Taylor Ave.
Garfield 4825

A mica part is like any other kind of part that goes into an assembly.
Speed of assembly depends very much upon uniformity of parts.
Mica parts, produced by Macallen from Macallen Mica, are accurate and uniform — they speed production.
When you specify Mica, go all the way and specify

MACALLEN MICA
THE ULTIMATE IN MICA

THE ULTIMATE IN MICA

send for Catalog



THE MACALLEN COMPANY

BAY ROAD
NEWMARKET, NEW HAMPSHIRE

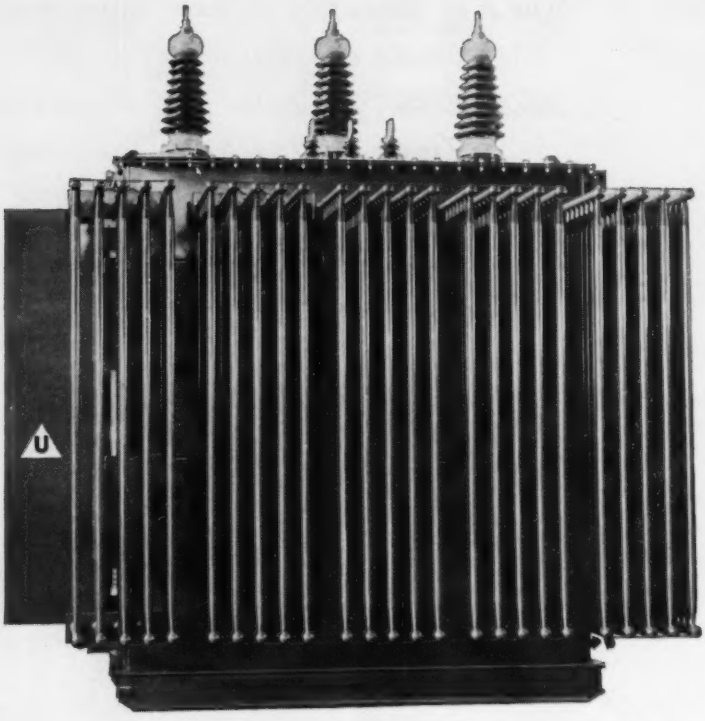
CHICAGO: 565 W. WASHINGTON BLVD.
CLEVELAND: 1231 SUPERIOR AVE.

Uptegraff LIQUID-FILLED *Transformers*

3 KVA

to

10,000 KVA



a complete line — STANDARD and SPECIAL RATINGS

ENGINEERING DATA

Helpful material for planning electrical systems

1. POWER. Bulletin 133 contains dimensions, performance data and other essential information on Uptegraff Power Transformers, 750 to 10,000 KVA.

2. LOAD CENTER. Uptegraff liquid-filled Load Center Transformers in eighteen ratings, from 150 to 2500 KVA, 3-phase are described in Bulletin 132-A.

3. DISTRIBUTION. This bulletin contains detailed specifications of Uptegraff liquid-filled Distribution Transformers, 150 to 500 KVA inc.—ratings, performance data, dimensions, weights and other data. Bulletin 136.

4. OVERHEAD. Characteristics, dimensional details, ratings and other data on Uptegraff type UD Overhead Distribution Transformers are given in Bulletin 135.

When requesting copies of above publications, please write on your company letterhead.

All standard commercial ratings from 3 to 10,000 KVA are available in the complete line of Uptegraff Liquid-Filled Transformers—and special designs are readily available for applications where standard units are not entirely suitable. Prompt deliveries can be arranged, and all Uptegraff Transformers are fully guaranteed. They meet or exceed ASA, NEMA and AIEE standards.

Extensive experience by this firm, which has specialized exclusively in the design and manufacture of transformers, assures the efficiency, dependability and long life of Uptegraff products. The Uptegraff Engineering Data Books illustrated at the left provide a wealth of information useful to executive, engineering and operating departments. We will gladly send copies to anyone interested. Please write on company letterhead.

R. E. UPTEGRAFF MANUFACTURING CO.

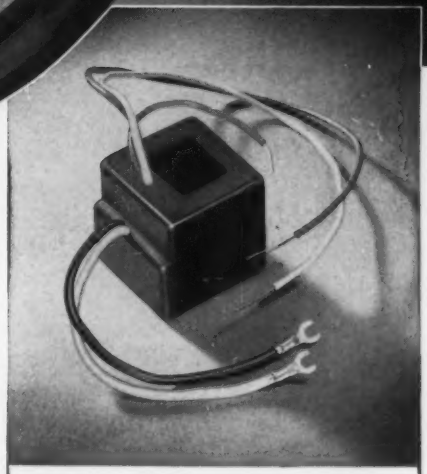
Scottdale, Pennsylvania

PROVEN ECONOMY BOOSTS USE OF SANGAMO J2T

The high accuracy, low maintenance, and long life of Sangamo J2T singlephase thermal demand-watthour meters set the pace for the greatly increased use of these combination units.

Their fine performance record helped boost total sales of all manufacturers by 16,313 more thermal combinations in 1955 than in 1954.

The J2T is ideally suited for application to singlephase residential and commercial loads. It is supplied with a 24 KW scale to take full advantage of the 100 ampere range of J2 Watthour Meter. It is also available with a 12 KW scale for power companies who measure demands on smaller loads and want indications above ¼ to ⅓ scale.



Better protection from lightning and high voltage surges

The insulation levels of the demand element and the watthour meter element of these combination meters are equally high. The potential transformer coil of the demand element is encapsulated in Sangamo Secolene, a specially developed epoxy resin with extremely high dielectric strength.

Write for more information on these cost-cutting demand meters today.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

8H56-S

The new and improved
HIGHWAY heavy-duty
"swing-base"

EARTH-BORING MACHINE

DIGS THE HOLE
AND
SETS THE POLE
in any Soil!

HIGHWAY

Faster, easier positioning . . . efficient, trouble-free digging at any angle

The newly developed Highway "Swing-Base" Earth-Boring Machine allows the operator to rotate the base 180° — and then extend it up to 22". The boring machine will dig at any point within this arc and within the forward and aft traverse. Both movements are hydraulic, allowing finger-tip control.

The unit can be mounted on either a single rear axle truck or a tandem with optional hydraulic stabilizing supports. The "Swing-Base" Earth Borer will dig 9" to 36" holes in any soil, faster and easier than ever before.

New swing base and extension give remarkable versatility and extreme flexibility, allowing exact positioning regardless of location or angle of the truck.

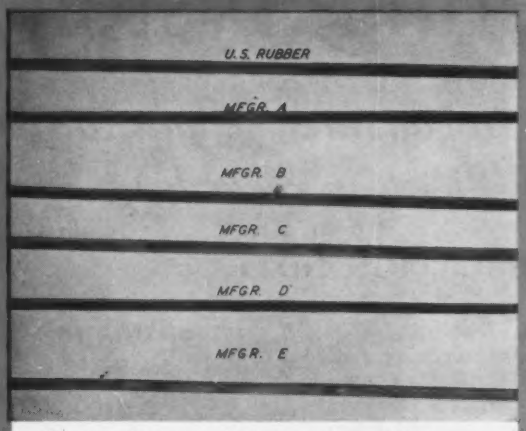
HIGHWAY UTILITY DIVISION
HIGHWAY TRAILER COMPANY

HEADQUARTERS: EDGERTON, WISCONSIN

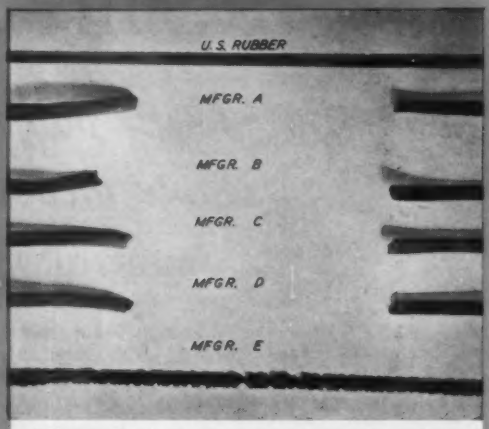
Manufacturers of: Public Utility Bodies • Earth-Boring Machines • Pole and Cable Reel Trailers • Winches • Power Take-offs • Service Accessories • Commercial Trailers • Trailerized Tanks and Dry Bulk Haulers.

SALES AND SERVICE IN PRINCIPAL CITIES

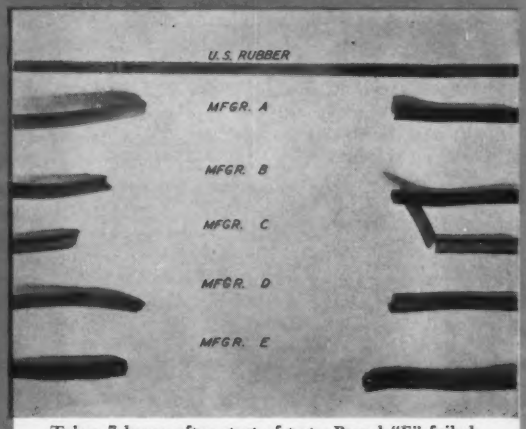
Grizzly High Voltage Power Cables



Here are 6 samples of widely used competitive neoprene jackets (stretched 200% of original length) at start of test for ozone resistance.



2 hours, 23 minutes after start. Brand "E" is disintegrating. Brand "B" has failed 13 minutes ago; the other brands failed an hour or more before.



Taken 7 hours after start of test—Brand "E" failed after 2 hours, 30 minutes. U. S. Grizzly Power Cable's jacket showed practically no sign of damage. It did not fail until after 18 hours of exposure.

Proved far and away the winner in an Ozone test of 6 leading competitive jackets!

U. S. Grizzly® High Voltage Power Cables are unmatched in performance, durability and all-around economy. Order these superior cables from your "U. S." branch, distributor or write Electrical Wire & Cable Department, United States Rubber Company, Rockefeller Center, New York 20, N. Y.

Obsolete wiring can cause power failure, step up expense and push down your production. That's why it's important to make sure your plant is equipped with Adequate Wiring—adequate not only for today's needs but also for the increased electrical loads needed in your future growth.

Electrical Wire & Cable Department

United States Rubber

ADVERTISEMENT

Design Factors in Telemetering Systems

Four important points to consider in planning for remote measurement or recording

A BRISTOL APPLICATION NOTE

Telemetering systems provide a proven way to keep tabs on a remotely located process, pipe line, service or utility. In fact, any time remote indication recording, or control is required, telemetering can serve your needs.

Here are the four conditions which must be considered in selecting the best telemetering system for any installation.

1. VARIABLES

Most industrial variables can now be measured, computed, and converted into a form that can be transmitted electrically. Their number and variety influence circuit complexity and the appearance of the receiving panel. Some variables now being successfully telemetered include:

Pressure • Current and voltage • Temperature • Flow • Electrical power • Wind velocity • Liquid level • Motion • BTU's • pH Horsepower • Speed

2. FREQUENCY OF READING

While the majority of telemeter systems in service today are the point-to-point continuous recording type, complex networks and interrelated variables are making sophisticated approaches more and more necessary. The problem usually boils down to these questions: how often is measurement necessary, and what is the least costly way to install and run the system?

Five types of possible hook-ups are:

Continuous recording—where variables are critical and need constant watch.

Intermittent indicating—where variables need only be checked at intervals.

Continuous-Intermittent—where it is possible to separate more critical variables for constant and intermittent telemetering.

Grouped-Multiplex—where several measurements can be transmitted as a group over a single circuit into a "multiplexed" receiver.

Successive-Multiplex—where measuring points over a large area can be "multiplexed" at intermediate locations, then herded to the panel.

3. TERRAIN

The type of interconnecting circuit between the measuring transmitters and central panel usually depends on the terrain: its topography, weather, and degree of settlement. Hence, signals may be carried by one, or by combinations, of the basic transmission media:

Radio—various types of radio can be used to take signals over mountains, deserts, and seas.

Wire—strung wire or leased lines can cover plant, urban, and rural areas.

4. INSTRUMENTATION

Bristol Metameter® Telemeters are eminently adapted to any of the conditions of measurement frequency, variables, or terrain likely to be encountered in telemetering. Transmission can be provided over telephone circuits, carrier current, radio—including microwave, VHF and UHF—and private wires, multiplexing and selective calling. Under all sorts of conditions, thousands of installations, ranging from just a few to hundreds of instruments each, have proven the dependability and reliability of Bristol Telemeters—pulse width (or duration), differential transformer, and voltage types, as well as pneumatic systems.

For more information on how Bristol Telemeters can benefit *you*, write THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 20, Conn. 5.44

TYPICAL RECEIVING CENTER in multiplexed telemetering system.

BRISTOL *POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

● This new design makes larger ratings practical in tomorrow's power stations.

Reports on test generator — the first with both rotor and stator cooled by supercharging — show low temperature operation and exceptional electrical characteristics, including high reactances.

This supercharged generator design has now proved its advantages in size and performance over any previously built units.

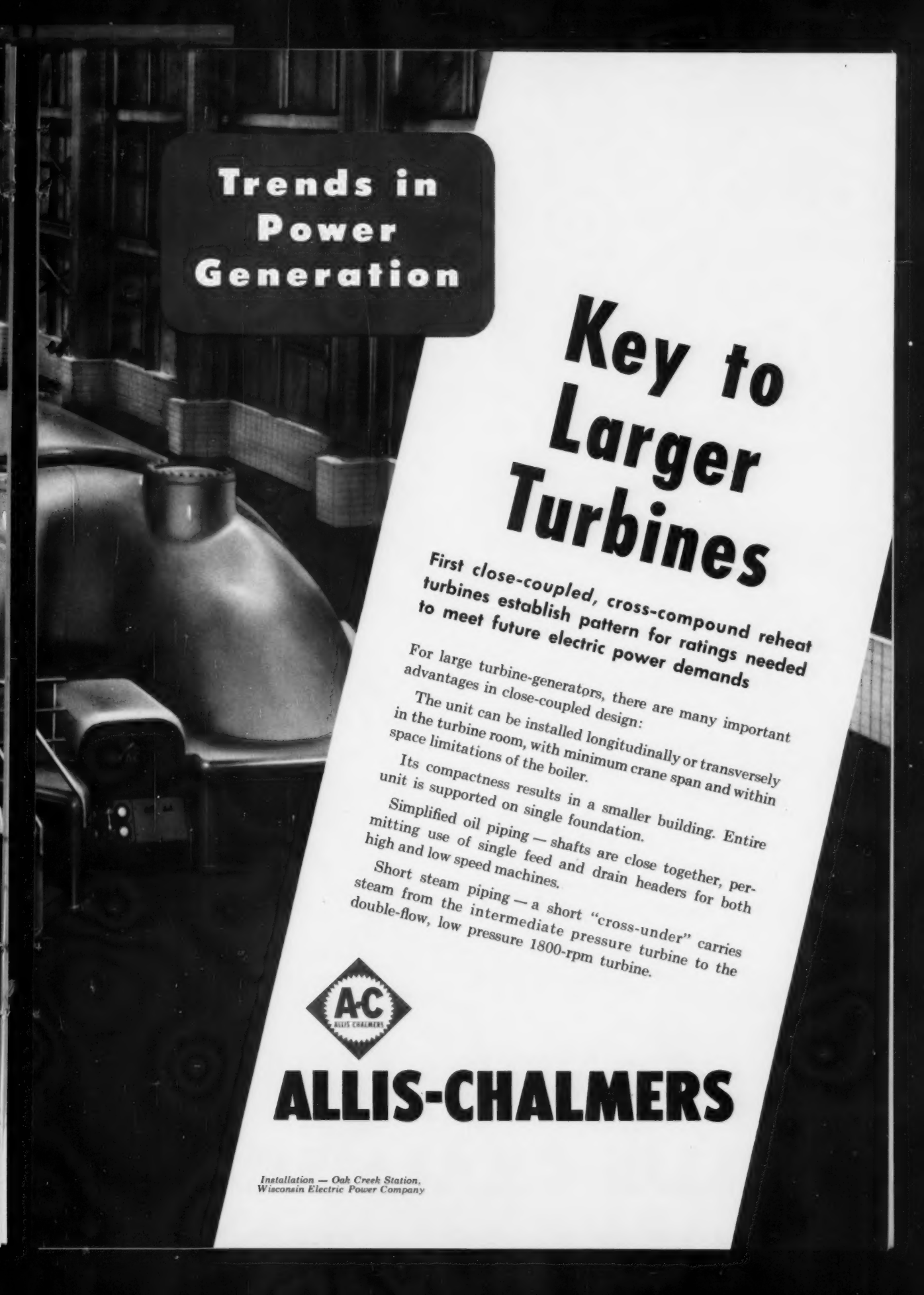
We will be glad to supply you with complete information on units of this type. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4737

ALLIS-CHALMERS
AC



Key to Larger Turbines

First close-coupled, cross-compound reheat turbines establish pattern for ratings needed to meet future electric power demands

For large turbine-generators, there are many important advantages in close-coupled design:

The unit can be installed longitudinally or transversely in the turbine room, with minimum crane span and within space limitations of the boiler.

Its compactness results in a smaller building. Entire unit is supported on single foundation.

Simplified oil piping — shafts are close together, permitting use of single feed and drain headers for both high and low speed machines.

Short steam piping — a short "cross-under" carries steam from the intermediate pressure turbine to the double-flow, low pressure 1800-rpm turbine.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Installation — Oak Creek Station, Wisconsin Electric Power Company

Choose Condenser Shape to Simplify Plant Layout

Get high operating efficiency of Multi-Steam-Path Condensers in Round, Oval or Rectangular shape

This adaptability of Allis-Chalmers condenser design adds flexibility to plant layout without sacrifice of efficiency. This means freedom for you in planning future power stations.

Multi-steam-path design makes all tubes completely effective by directing the steam to even the remote sections of the condenser, thereby producing a high vacuum.

Steam, penetrating all parts of the condenser, keeps condensate temperature high and drives off dissolved oxygen.

This combination of high vacuum, high condensate temperature and good deaeration means high operating efficiency.

Talk over the special requirements you have in mind for future stations with Allis-Chalmers engineers. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

CABLE TAPE

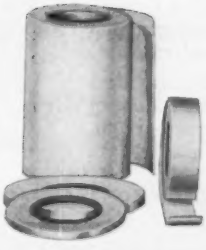
FRICTION TAPE

PLASTIC TAPE

NEOPRENE TAPE

RUBBER TAPE

LAMINATED INSULATING MATERIALS



Specify CHASE

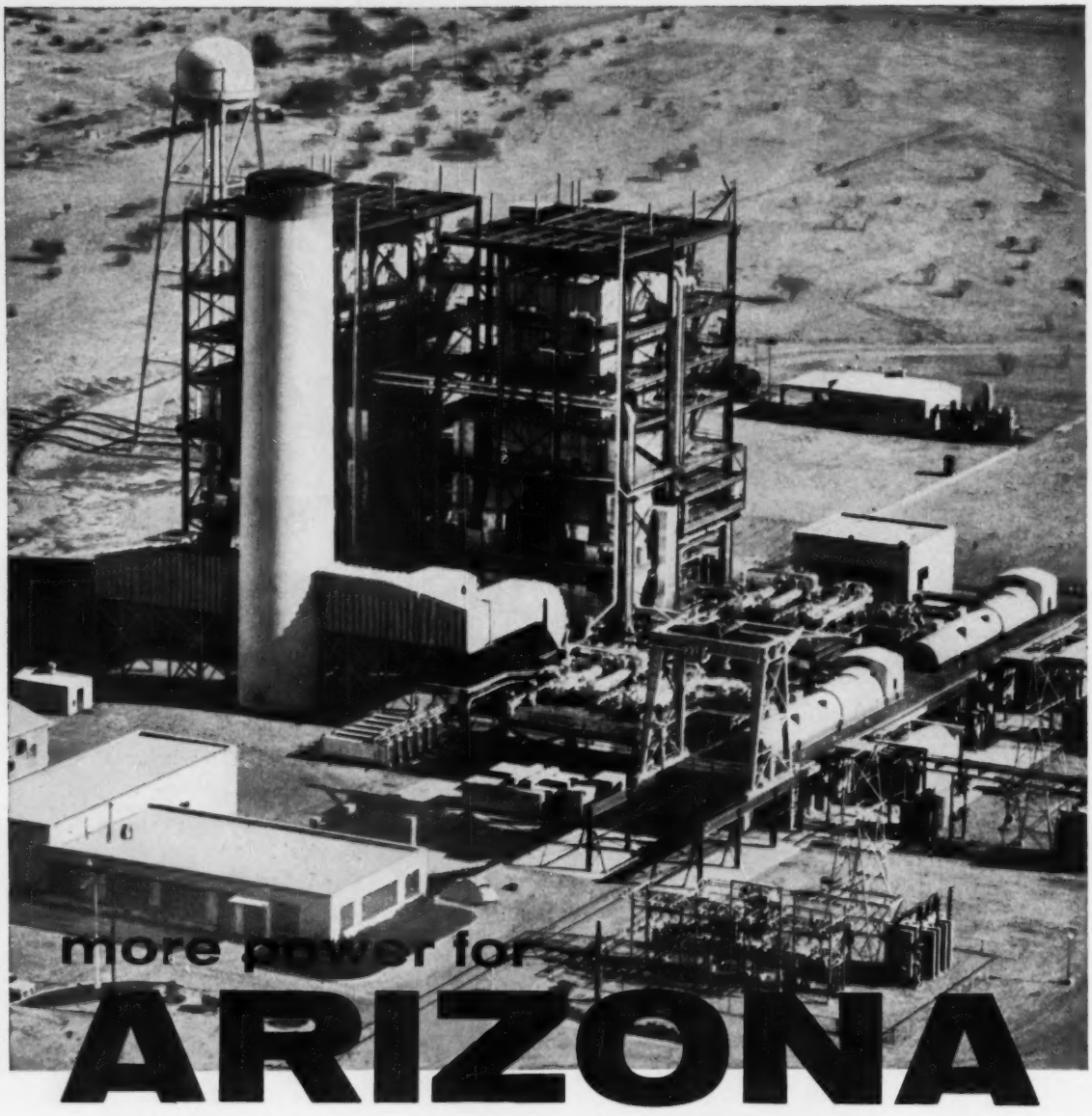
ELECTRICAL INSULATING MATERIALS

There is a difference in electrical insulating tapes, and you can be sure of top quality when you specify Chase. All Chase tapes are made to meet the high standards of the electrical industry and offer excellent electrical and physical properties, with guaranteed footage in every roll.

Chase also has pioneered in the development of Class "H" and Class "B" laminated insulating materials of purified asbestos and DuPont Mylar ® in a variety of combinations for original equipment insulation.

Write today for your copy of the handy Chase Insulation File describing the complete line. Chase & Sons Inc., Randolph, Mass.

Write for CHASE Electrical Insulation File



With the completion and placing in operation of the Saguaro Steam Electric Station, the Arizona Public Service Company makes available an additional 200,000 kw of electric power for Arizona's industrial and domestic needs.

Ebasco takes pride in having served Arizona Public Service Company in the design and construction of this modern plant.

For more information about the services Ebasco offers business and industry, send for "The Inside Story of Outside Help." Address Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, N. Y.

ENGINEERS · CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

NEW YORK · CHICAGO · DALLAS · PORTLAND, ORE. · WASHINGTON, D. C.

Appraisal · Consulting Engineering · Design & Construction · Financial & Business Studies · Industrial Relations · Insurance, Pensions & Safety
Purchasing, Inspection & Expediting · Rates & Pricing · Research · Sales & Public Relations · Space Planning · Systems, Methods & Budgets · Tax · Washington Office

for easy handling

AWG 14-6 in cartons
AWG 4-2 in wrapped coils
AWG 1-1,000,000CM on reels

Southwire

BUILDING WIRE

type TW
full range of sizes
standard colors
UL approved

Southwire type TW building wire is conveniently packaged for easy warehousing and installation—Underwriter Laboratory approved and suitable for general use in conduit, raceways or on insulators. All Southwire TW is oil, moisture and flame resistant and approved for wet location installations. Smaller sizes are prelubricated for ease of pulling in conduit.

Order Southwire TW and get Southwire service automatically—rapid delivery via our own trucks from the most complete mill warehouse stock in the South.

SOUTHWIRE PRODUCTS

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene Weatherproof Copper, Aluminum and Triplex
- Polyethylene Weatherproof Copper, Aluminum and Triplex
- Southwire Vinyl Weatherproof Copper, Aluminum and Triplex
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories

"SOUTHWIRE MEANS SERVICE"

Southwire Company

TErrace 2-6311 CARROLLTON, GEORGIA

1
2
3
ELECTRIC

PROVIDE BEST PROTECTION
With Isolating External Gap
VALVE Arresters

These isolating external gap arresters are the result of Electric Service development and field engineers taking all of the finest service-proved features of Crystal Valves . . . putting them into one arrester . . . and adding a feature sought by thousands of utility men.

1. **The isolating external gap provides positive protection from line lockouts.**

2. **Exclusive "T" Grain Silicon Carbide valve element is unaffected by moisture or age. It has the highest thermal and surge current capacity of any valve element material.**

3. **Ultra-Speed Multiple Arcing unit, coordinated with external gap results in impulse sparkover slightly higher than the standard Crystal Valve, but below the industry average for all valve type arresters. This is true even with the arrester bracket not grounded.**

Isolating external gap Crystal Valve Lightning Arresters are available for both cross-arm or tank mounting. Their applications are not limited by values of surge or fault current. Write today for full details on these service-proved external gap VALVE arresters.

SERVICE MANUFACTURING CO. Philadelphia 32, Pa.

MIF

malleable iron

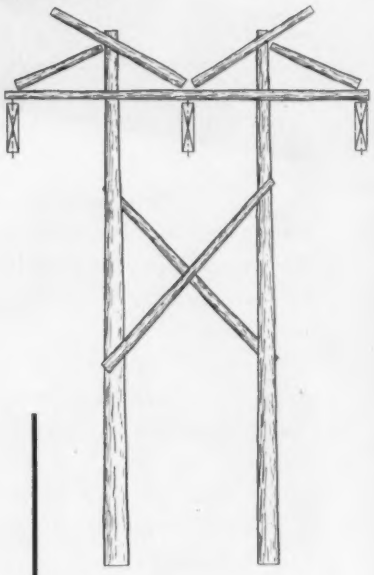
high corrosion resistant

TRANSMISSION LINE FRAMING HARDWARE!

Only MIF offers a complete line of fully engineered, field tested, *malleable iron* framing hardware: Grid Gains; Timber Connectors; Spar Arm Gains; Washers and Accessory Hardware.

Only *malleable iron* offers the engineer the opportunity to design complex or simple framing structures where material strength and corrosion resistance in framing hardware assures a longer and more balanced life expectancy throughout the structure. . . . . *without increasing cost!*

For further information
Write for Bulletin PH 10.



LONGER LIFE
LOWER COST
EASIER INSTALLATION
FEWER DESIGN LIMITATIONS

MALLEABLE IRON FITTINGS COMPANY

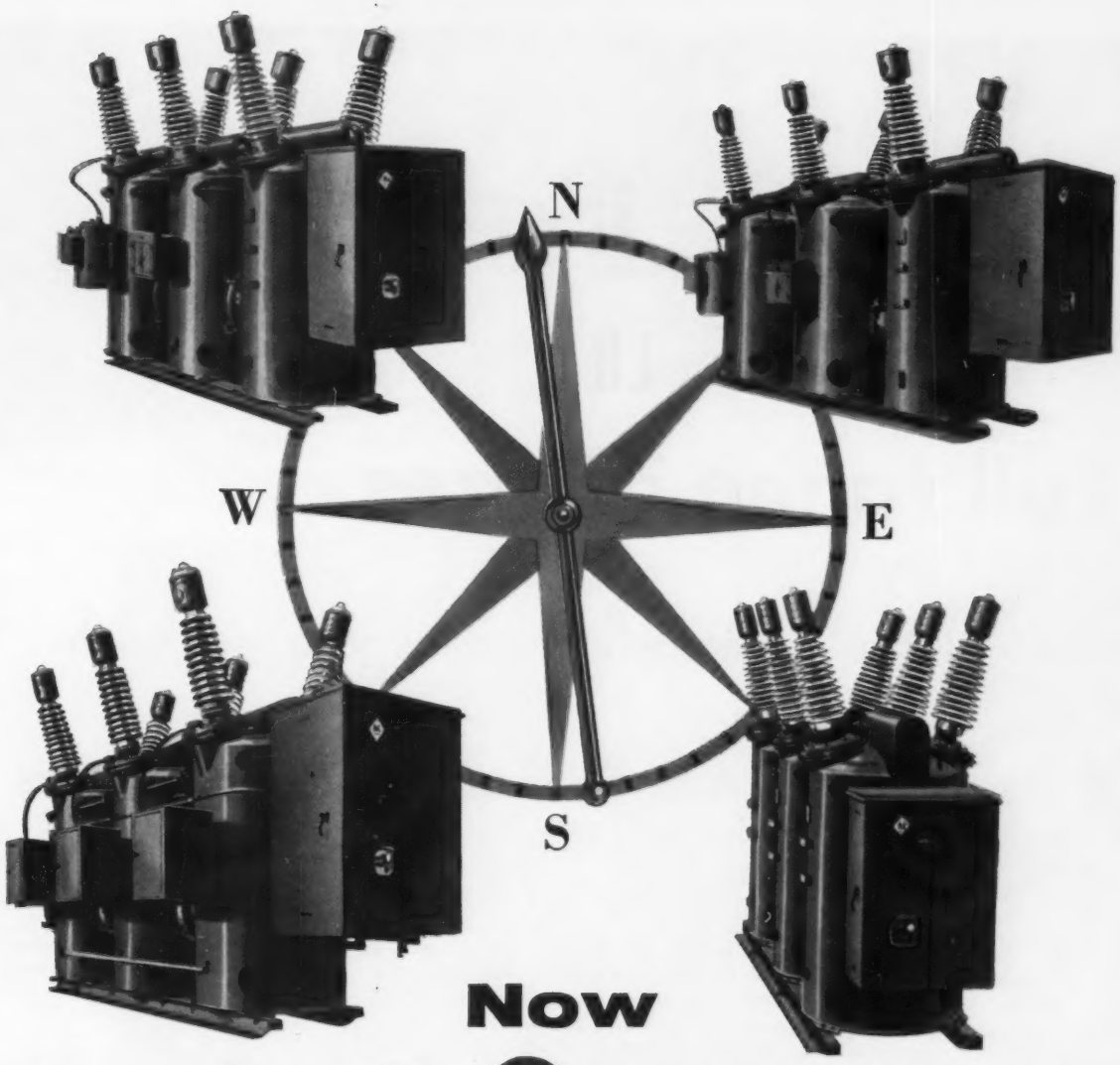
POLE HARDWARE DIVISION

Branford, Connecticut

MIF

Canadian Mfr. & Dist.: LINE & CABLE ACCESSORIES, Ltd. TORONTO

Representatives: William J. Cottrell Co., Portland, Ore. • James H. Drew Corp., Indianapolis, Ind. • Industrial Engr. & Equip. Corp., Los Angeles, Cal. • JSG Electric Co., Chicago, Ill. • Lee-Smith Co., Miami, Fla. • B. H. McCoin, Knoxville, Tenn. • William J. O'Brien, Memphis, Tenn. • Robert P. Smith & Co., Jacksonville, Fla. • E. A. Thornwell, Inc., Atlanta, Ga. • J. P. Voight, Summerville, S. C. • Waltham, DeWitt & Krusi, San Francisco, Cal. • L. G. Wendegatz, Kansas City, Mo. • Williamson Sales Co., Shreveport and New Orleans, La.; Dallas, Houston, Tex.; Pine Bluff, Ark. • O. C. Witte Co., Detroit, Mich.



Now *Pneu-Draulic* Operators

used on ~~30~~ 39 Power Systems

In the last six months, 9 more power systems have installed Allis-Chalmers hydraulically operated circuit breakers.

This is remarkable acceptance and it's due to several reasons. *Pneu-Draulic* operators are both simple and reliable . . . and they eliminate such common operating problems as moisture, condensation, dust and dirt.

Repeat orders are growing, too. This in itself is proof of the excellent performance of breakers with these operators under a wide range of field conditions.

Isn't it time you try an Allis-Chalmers breaker with *Pneu-Draulic* operator on your system?

Get information from your nearby A-C office or write for Bulletin 71B7942. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Pneu-Draulic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4972

Full range of sizes . . .

One of the basic advantages you get with

BTC DROP-FORGED

MPL Aluminum Suspension Clamps

BTC OFFERS YOU a choice of exactly the right clamp for each size of A.C.S.R. or all-aluminum conductor. The close dimensional fidelity of the die-forged and die-formed parts makes unnecessary any bore size allowance for manufacturing variations in the clamps.

FULL RANGE OF SIZES is just one of many advantages you get by specifying BTC Drop-Forged Aluminum Suspension Clamps. These strong, lightweight clamps give longer service . . . increase conductor life . . . and provide cool, trouble-free operation with a minimum of power loss.

* * *

NEXT TIME you order from your insulator manufacturer, ask for BTC Aluminum Suspension Clamps. They are an important part of BTC's complete line of forged transmission line hardware.

TWELVE CLAMP SIZES are offered . . . each obtainable with socket, clevis eye or without adapter for use with U-Bolts or J-Bolts. A total of 72 variations are available.

BTC *Specify*

DROP-FORGED Hi-Line Hardware

. . From Your Insulator Manufacturer

THE BREWER-TITCHENER CORPORATION, Cortland, N.Y.

NO OTHER TAPE

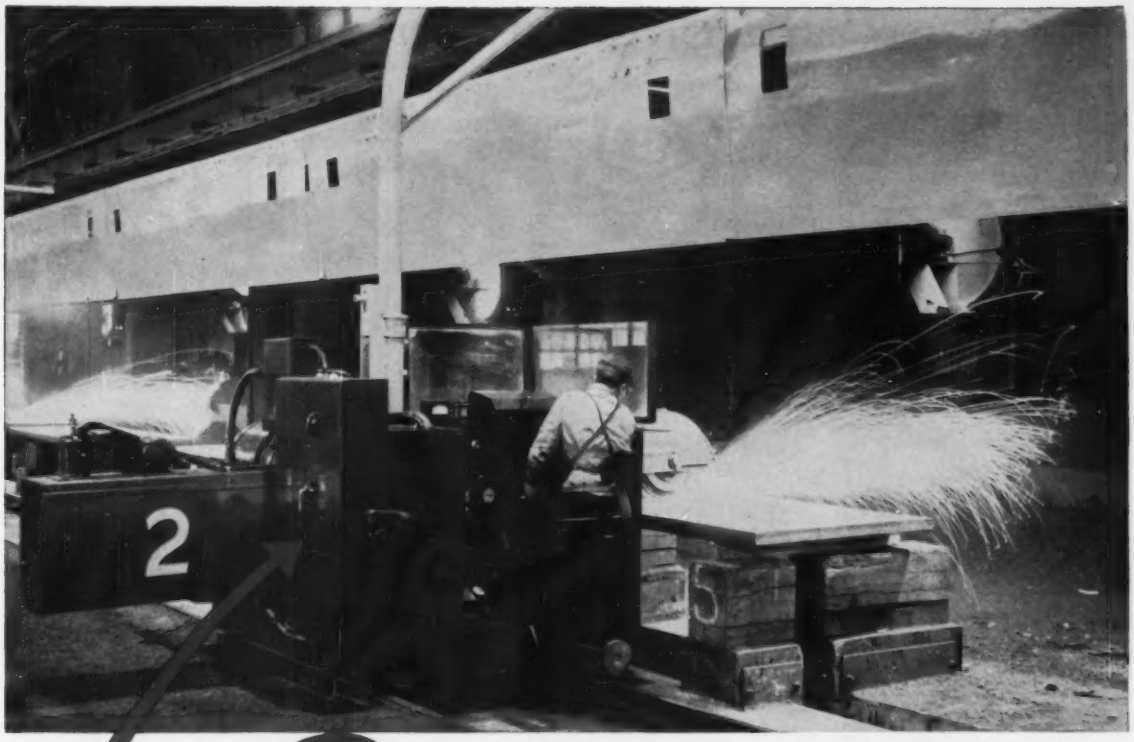
has all these advantages for insulating Service Drop Connections

PROPERTIES OF BI-SEAL	
PHYSICAL:	
Color	black
Thickness	.020 inches
Elongation (Min.)	350%
SHELF LIFE OPERATING TEMP.	UNLIMITED —40° C. to 80° C.
CHEMICAL:	
WATER ABSORPTION	.0065%
Ozone	passed
Corrosion	none
Acid Resistance	excellent
Alkali Resistance	excellent
Vegetable Oils	excellent
Hydraulic Fluids	excellent
ELECTRICAL:	
Dielectric Constant	2.2 (1000) cycles
Power Factor	.0006 (1000) cycles
DIELECTRIC STRENGTH	1000 v/mil
Volume Resistivity	$>10^{15}$ ohm-cm

APPLIES FAST • STAYS FAST
BI-SEAL
BISHOP
MANUFACTURING CORPORATION
12 CANFIELD ROAD, CEDAR GROVE (ESSEX CO.) N. J.

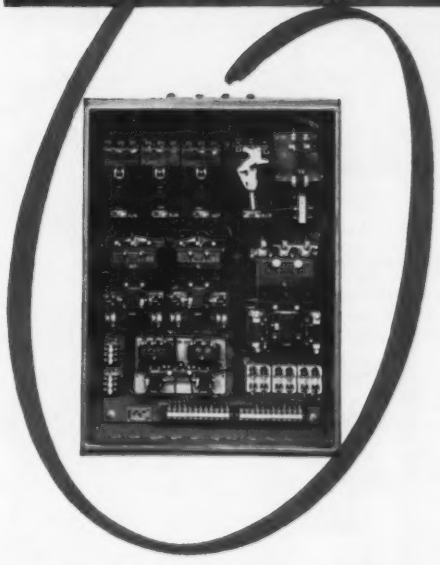
Data in the table above represent average test results and should not be used for specification purposes.

Complete technical and descriptive data on BI-SEAL and other outstanding Bishop Tapes is included in this attractive catalog . . . yours for the asking.



CLARK Type "CY" CONTROLS

help Mid-West Slab Grinders triple output at Crucible Steel!



Clark Type "CY" Control Panel mounted on each machine contains a size 0 reversing, two size 2 and one size 3 Type "CY" motor starters.

Ten track mounted billet grinders built by the Allied Machine and Engineering Co., a subsidiary of Mid-West Abrasive Company, are setting new performance standards at Crucible Steel's Midland, Pa. mill. Replacing manually operated and unwieldy swing grinders, these machines do the job better, faster and safer with electrically-controlled hydraulic positioning.

Accurate and complete control of stroke, wheel position, rotation and pressure results in smaller metal loss, less wear on grinding wheels and better finish. Clark Controls provide the accuracy and dependability these machines require, and prove again that Clark Type "CY" starters have the extra stamina required for heavy-duty mill-type service.

The **CLARK** **CONTROLLER** *Company*

Engineered Electrical Control

1146 East 152nd Street • • Cleveland 10, Ohio

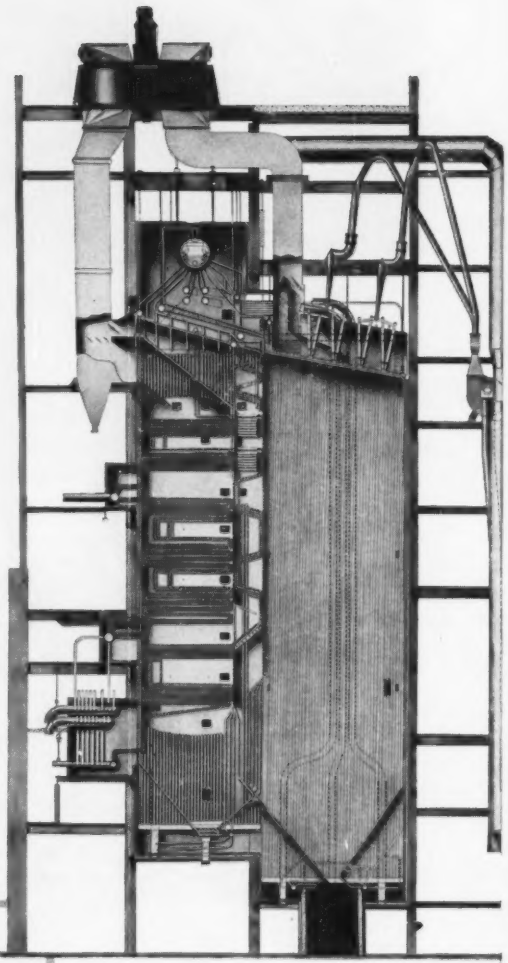
IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

Now on the Line at Duquesne Light

1,060,000 lb/hr

Reheat Steam Generator by FW

Sixth Foster Wheeler Steam Generator at Phillips Station marks latest expansion of Duquesne system ... an expansion that will soon include atomic power at Shippingport, where FW Steam Generators will also serve



The capacity of the Phillips Station of Duquesne Light Company was increased by 156,200 kw when Unit No. 4 went on the line in January 1956. This, the largest and most efficient unit in the Duquesne system, is served by the 1,060,000 lb/hr Foster Wheeler reheat-type steam generator shown at the right.

The addition of Unit No. 4 brings total capability of Phillips Station to 382,000 kw. *All four* of these units are powered by Foster Wheeler steam generators — a tribute to customer satisfaction that dates back to the first installation in 1942.

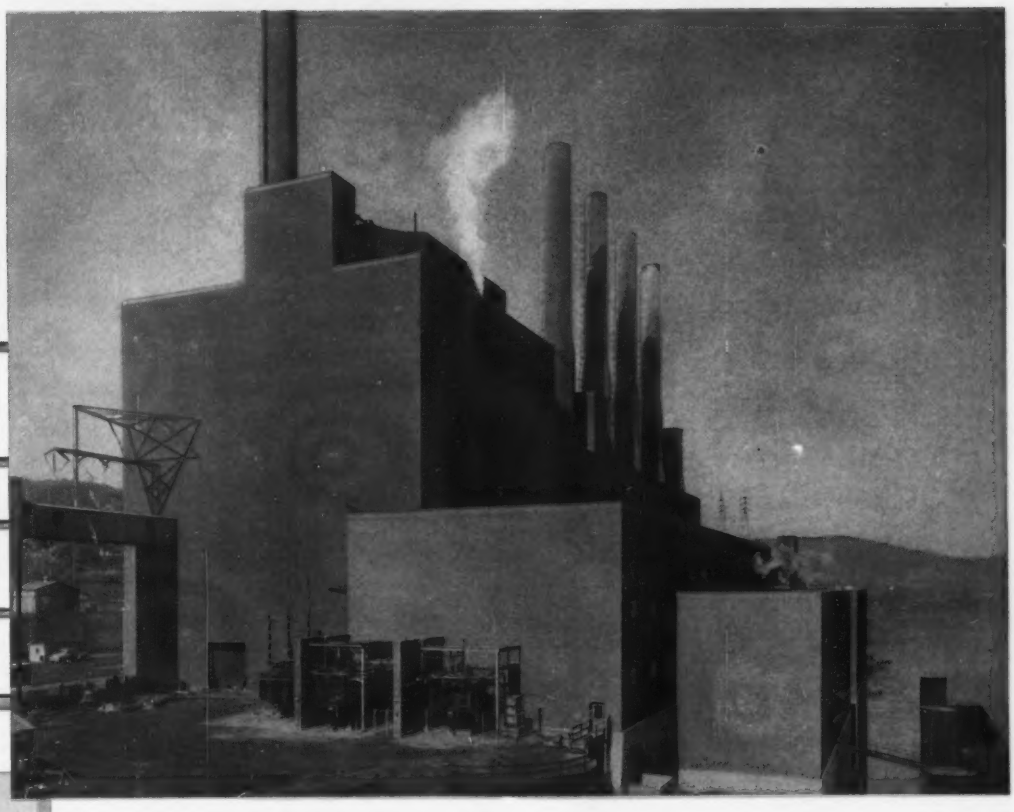
In the nation's first full scale atomic power plant, now under construction at Shippingport, Pa. and scheduled for completion in 1957, two Foster Wheeler steam generators (heat exchangers) will be used to convert heat from the nuclear reactor to 600 psi steam.

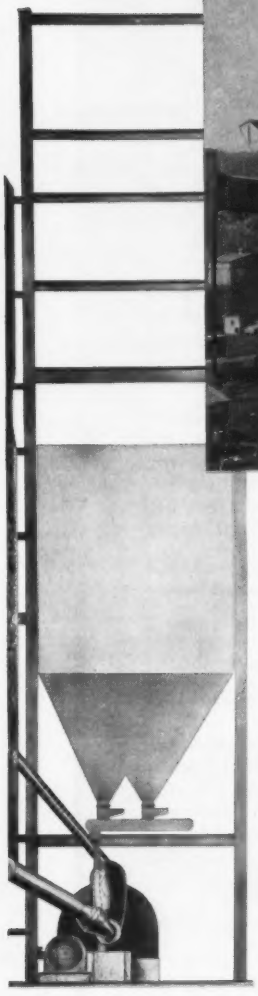
Whatever your Power Plant requirements — from coal or oil firing to nuclear energy — heat engineering by Foster Wheeler means efficient and dependable steam generation at low overall cost. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

FW STEAM GENERATORS AT DUQUESNE'S PHILLIPS STATION

1942 — TWO twin-furnace units, 500,000 lb/hr, 900 psi, 900F
1949 — ONE twin-furnace unit, 700,000 lb/hr, 900 psi, 900F
1950 — TWO twin-furnace units, 700,000 lb/hr 900 psi, 900F
1956 — ONE divided-furnace, reheat unit, 1,060,000 lb/hr, 1850 psi, 1000/1000F

Company's Phillips Station:





The FW steam generator for Unit No. 4 at the Phillips Station above is shown in cross section at the left. It delivers 1,060,000 lb steam per hour at 1,850 psi, 1,000F at the superheater outlet and 1,000 F reheat. The primary steam temperature is controlled at 1,000F over a load range from 689,000 to 1,060,000 lb/hr by spray control. Reheat temperature is also controlled at 1,000F over the same load range by gas by-pass.

This 44-ft high furnace is vertically fired by 12 FW intertube burners located in the roof. The furnace is divided into three firing cells; the front, side and division walls containing waterwall surface while the rear wall is of radiant superheater surface. Furnace exit gases are divided into two passes, with convection superheater, convection reheater, and bare-tube economizer in the main pass, and convection superheater and extended-surface economizer in the by-pass section.

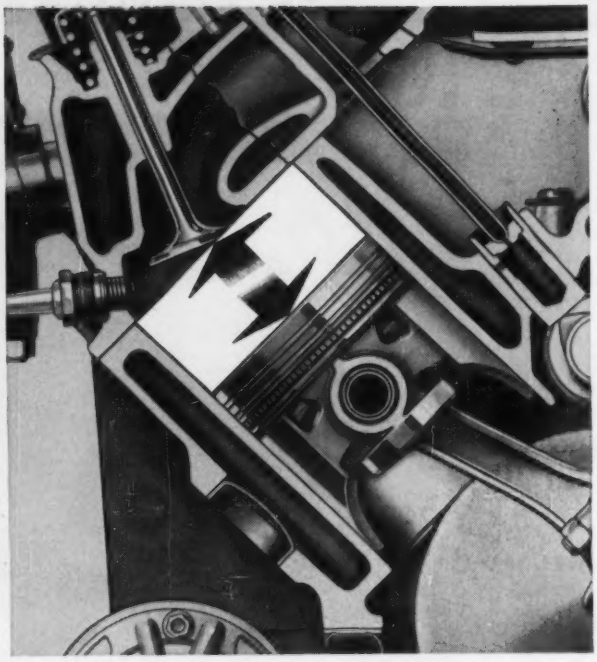
Coal for this 1,060,000 lb/hr unit is pulverized by two of the largest ball mills ever installed. These Foster Wheeler D-8D suction-type ball mills have a capacity of 67,000 lb of coal per hour, ground to a fineness of not less than 75% through a 200 mesh sieve and not less than 99% through a 50 mesh sieve. The pulverized coal-air stream is drawn from both ends of the double-ended mills and piped to four distributors near the top of the furnace, each distributor dividing it three ways so that each pulverizer exhaust feeds a burner in each of the three furnace cells. This assures a very even distribution of heat across the furnace.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

SHORTEST STROKE V8 OF ANY LEADING TRUCK!

. . . one reason for top-notch fuel economy, low maintenance costs in this New Chevrolet Truck V8



That picture above gets right to the heart of a *modern* performance champ, the new Chevy Trademaster V8!* The arrow points up the *shortest stroke* of any leading truck engine—your assurance of power that eats up work while using less fuel, and minimum engine wear stemming from reduced piston travel.

This shorter stroke has brought about a whole new concept of more efficient engine design, exclusive with Chevrolet truck V8's. Because of it, Chevrolet engineers have been able to make the Trademaster V8 the *most compact truck engine on the market, with more horsepower per pound than any other*. "Dead weight" has been pared off to give you the efficient performance you want, more pound-pulling power!

So, remember this *special kind* of short-stroke design Chevrolet truck V8's now bring you. Remember what it means in terms of money-saving, profit-making hauling. Certainly, you'll want to see your Chevy dealer soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

**Optional at extra cost in 3100 through 4500 models.*

The dollar-saver that looks like a million!

Here's modern truck beauty that adds to your business prestige! Long, low, forward-sweeping lines provide good advertising for you wherever you go. And you'll go more easily, too, thanks to the nimble maneuvering these new Chevy models provide!

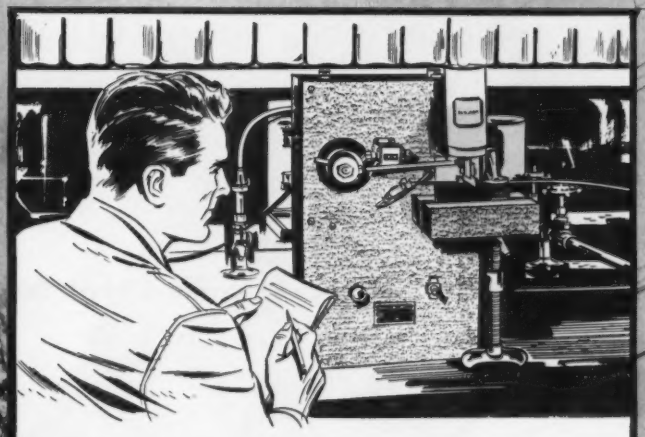
CHEVROLET

NEW CHEVROLET TASK·FORCE TRUCKS

Anything less is an old-fashioned truck!

Demonstrated in the laboratory

proved in the field



Du Pont ALATHON® has 27% superior abrasion resistance

POLYETHYLENE RESIN

Superior abrasion resistance is one important reason why "Alathon" polyethylene resin gives outstanding performance as an electrical jacketing and insulating material.

The extra toughness and durability of insulation and jacketing of Du Pont "Alathon" were dramatically demonstrated in the laboratory by means of a scrape test. A reciprocating blade set perpendicular to the jacketing abraded ordinary polyethylene from the conductor after 341 cycles. Under the same conditions, the wire jacketing of "Alathon" withstood the blade action through 433 cycles—an increase of 26.9%. Final proof, of course, comes in the field where "Alathon" provides more years of trouble-free service.

In addition to superior abrasion resistance, "Alathon" features low power loss and low dielectric constant, flexibility even at extremely low temperatures and outstanding moisture, chemical and heat resistance.

With insulation and jacketing of "Alathon," you get cable that is light in weight, flexible and easy to handle. Installation is speeded by its ease of pulling, cleanliness in handling, and simplified jointing and terminating requirements. To get complete property and application data on "Alathon," clip and mail this coupon.

There is a difference in polyethylenes . . . insist on insulation and jacketing of ALATHON®

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 355, Du Pont Building, Wilmington 98, Delaware

In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Please send me complete information on Du Pont "Alathon" polyethylene resins. I am interested in evaluating these materials for

_____

Name_____

Position_____

Firm Name_____

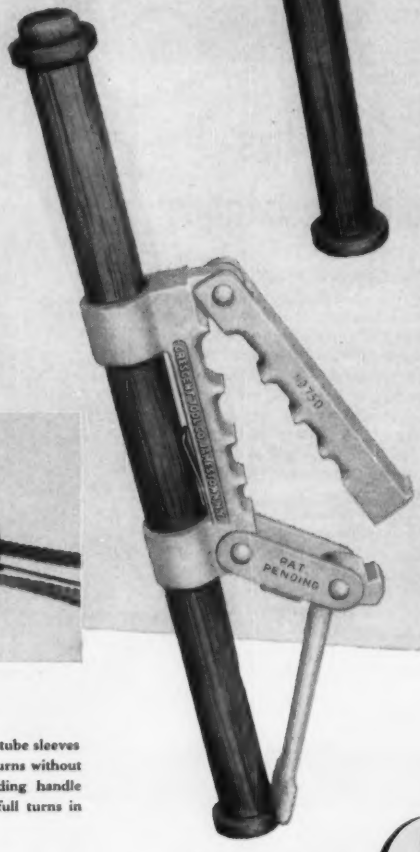
Street Address_____

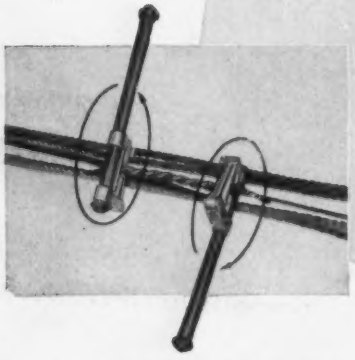
City_____ State_____

Type of Business_____

CRESCENT SLEEVE WRENCHES

insure better joints... ...faster and safer to use





Both single and double tube sleeves can be twisted six full turns without cracking or injury. Sliding handle clears tackle, allowing full turns in close quarters.

FEATURES

Oil impregnated hickory handle makes practically perfect insulation, preventing flash if contacted with hot wire.

Cam and lever action closes jaws easily and locks positively when closed. Readily released with one hand even with heavy gloves. Conveniently carried in loop of tool belt.

Design of the openings is such that maximum strength of the joint is secured. Tests indicate that joints made with No. 750 Sleeve Wrench give nearer 100 percent of the theoretical strength of the sleeve than with any other method.

SPECIFICATIONS

Finish—Metal parts are cadmium plated. Hickory handle impregnated with linseed oil.

Material—Jaws and cam lever are heat treated, forged steel.

Length—Overall, 20 inches.

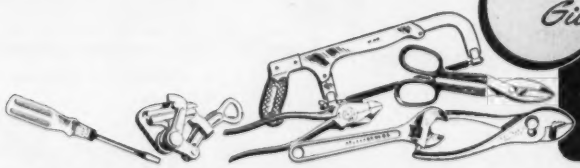
Weight—5 lbs. 3 oz. a pair, boxed.

Packed—Two in a box. Order in pairs.

Handles—Handles 20 inches long are standard.

Capacity—Any sleeve, copper or aluminum, up to and including No. 3/0 solid copper, No. 2/0 stranded copper or No. 1/0 ACSR. Two, three or four openings can be put in one wrench, depending on opening sizes.

CRESCENT TOOLS
Give Wings to Work
Sign of the Artisan
Symbol of Excellence



Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Progress in turbine-generators

How General Electric provides maximum reliability in turbine-generator armature insulation

About preceding page illustration

HIGH-VOLTAGE TESTS TO DESTRUCTION are used to determine how much G.E.'s armature insulation can withstand. Forced to carry voltages far above their rating, test bars first develop corona streamers, then finally fail, enabling engineers to discover the insulation's actual voltage strength.

99.85% service availability highlights performance of turbine-generator armature insulation

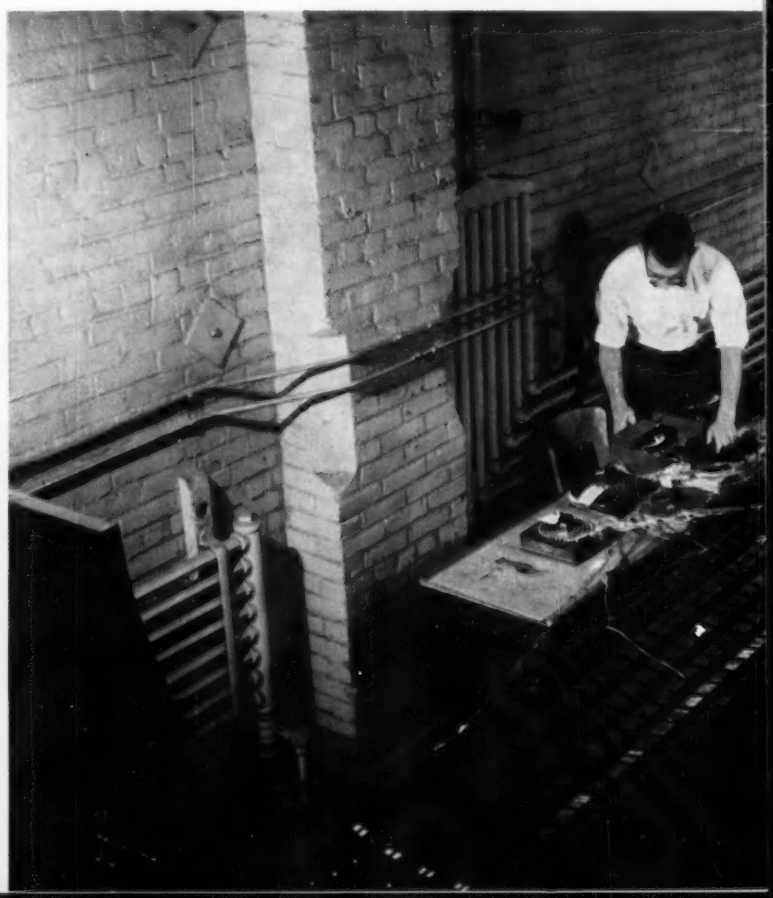
G-E design combines both electrical endurance and mechanical toughness

Primary among the many factors affecting a turbine-generator's long-term service availability is the quality of its armature insulation. It must withstand high voltages over long periods of time. And at operating temperatures it must endure the variable stresses caused by differential thermal expansion and contraction within the generator.

General Electric insulation measures up to these requirements with an already proved service availability of 99.85 percent in turbine-generators.

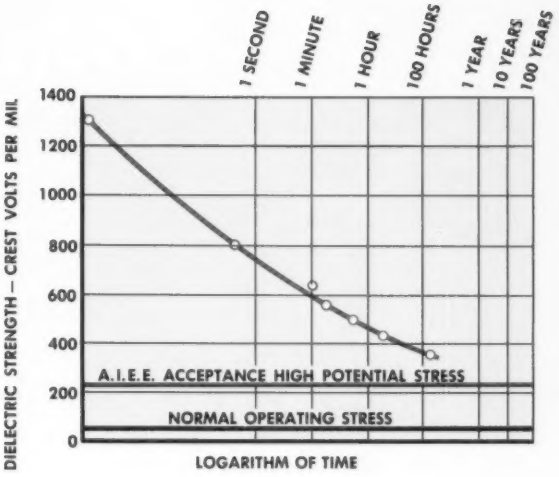
Progress in other areas of generator development often influences the performance of insulation. Larger capacities, higher voltages, different cooling methods all present new problems. To make sure that insulation quality keeps pace, each new generator development includes rigorous tests of insulation under the new set of conditions.

The illustrations on these pages show typical insulation tests constantly under way at General Electric's turbine plant.

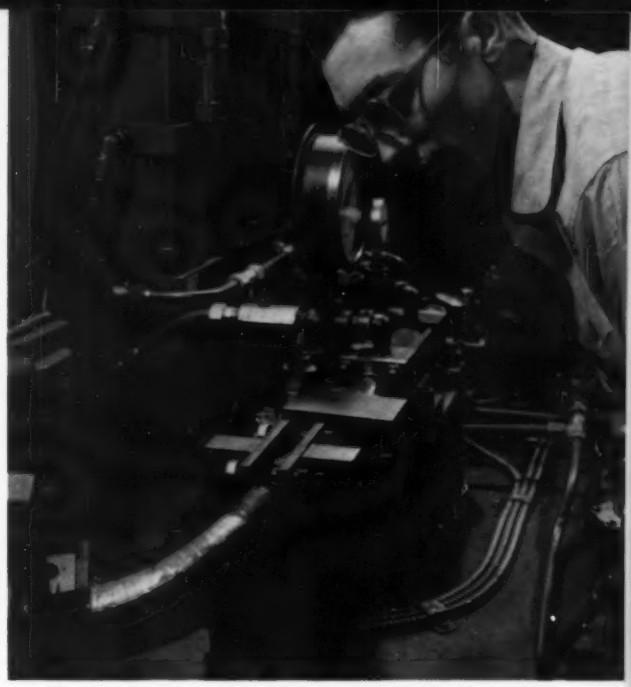


G-E APPLIED RESEARCH is typified by this full-size armature bar test. Here, General Electric engineers find out how well insulations can withstand the mechanical stresses caused by differential thermal expansion and contraction within an operating generator.

To simulate actual operation in this special 17½-foot core section, high currents are run through full-size stator conductors to build up heat; then are shut off while the apparatus is cooled by blowers. This procedure can reproduce ten years of anticipated operating stress cycles in just four months of testing. This important test provides an accurate means of evaluating both present insulation materials and new ones under development.



HIGH-VOLTAGE ENDURANCE of G-E insulation over long periods of time is graphically illustrated here. This record invites comparison with that of any other turbine-generator insulation in service today.



FLEXING TEST determines the insulation's ability to withstand bending caused by expansion and contraction or by short circuits. Here, a G-E engineer evaluates performance of the critical end portion of an armature bar.

EVERY GENERATOR leaving the factory has passed a series of searching high-potential tests. A sample bar, selected at random, is tested to failure. For quality control, each bar is separately subjected to voltage stresses of more than five times normal operating stress. When installed in the generator, the bar is again tested at voltages producing 3½ times normal operating stress. Immediately following generator running tests, windings are "hot high-potted" at operating temperatures, and finally tested at room temperature just prior to shipment.

Leader in Turbine-Generator Progress

GENERAL ELECTRIC

G-E engineers are developing new insulations for larger machines

In the picture above, a G-E development engineer is shown inspecting one of tomorrow's insulations now being developed in the Large Steam Turbine-Generator Department's Materials and Process laboratory. A special processing mill is being used to treat the new type insulating material. The rollers increase homogeneity and orient the structure for improved mechanical and electrical properties.

One of the new materials coming out of this applied research is Micapal, a mica-based synthetic insulation which shows marked improvements in dielectric strength, thermal conductivity, heat endurance, and mechanical strength. The first generator utilizing Micapal has been in commercial operation for more than two years.

Micapal and other insulations now under development will help continue General Electric's record of turbine-generator progress.

If you would like more information on G-E turbine-generator development, contact your nearest G-E Apparatus Sales Office, or write for Bulletin GER-1047, "Research and Development in the Field of Turbine-Generator Prime Movers in the General Electric Company." Large Steam Turbine-Generator Department, *General Electric Company, Schenectady 5, N.Y.*

254-28

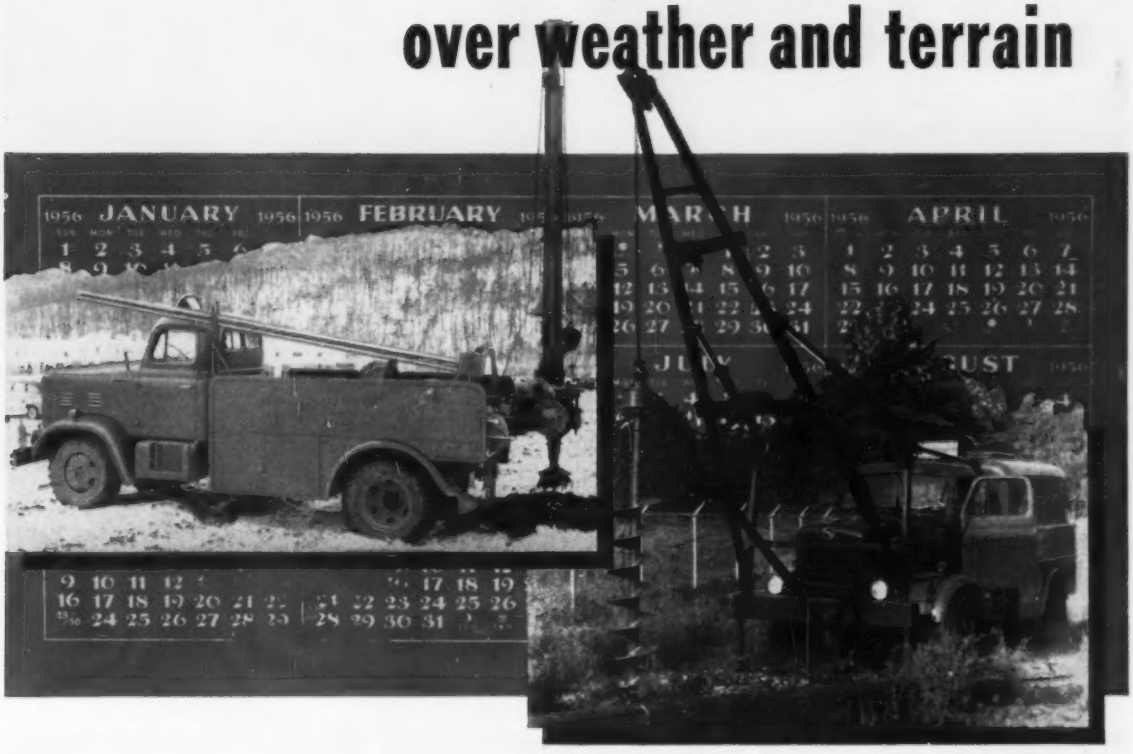
Progress Is Our Most Important Product

GENERAL ELECTRIC

every day – or in emergencies...

YOUR ONLY CONTROL

over weather and terrain



There are no normal work conditions in line work. Sunshine or sleet, sand, mud or snow, hill or hollow . . . they're all in the day's work. The only control you have over weather or terrain is a Four Wheel Drive truck!

FWDs ask no questions. They just get there and do the job. The new FWDs are fast and flexible for scattered line maintenance jobs. They're rugged and dependable for tough line construction assignments.

You can choose the type of body that fits your requirements and the power and weight proportioning that's best for your terrain. There are front or rear-mounted derricks and diggers with power take-off designed for utility tools.

This is the truck that's as dependable as your service has to be. Efficient for the day-to-day jobs but with a priceless power reserve for emergencies. Find out how the versatile new FWDs fit your service requirements!

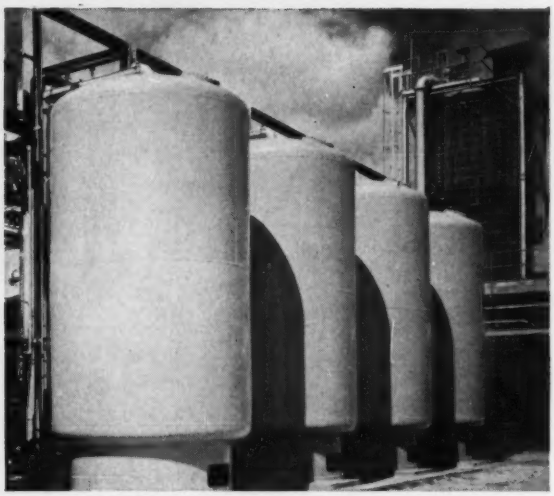
BUILDERS OF AMERICA'S FOREMOST HEAVY DUTY TRUCKS

FWD

MATH-MATIC DESIGN

THE FOUR WHEEL DRIVE AUTO COMPANY • CLINTONVILLE, WISCONSIN • *Canadian Factory* • KITCHENER, ONTARIO

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

How Permutit® Solves a Water Problem

U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

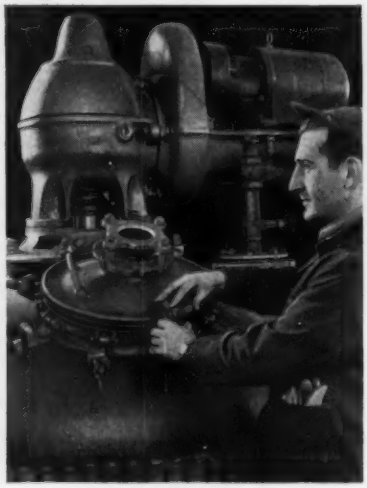
• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.

• **Manufacturing** – After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

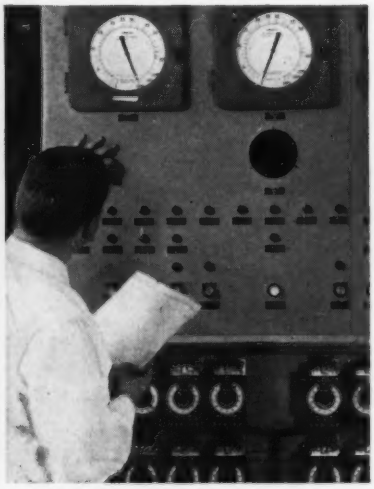
• **Test runs** – Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. EW-5, 330 West 42nd St., New York 36, N. Y.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

Butarone Insulated

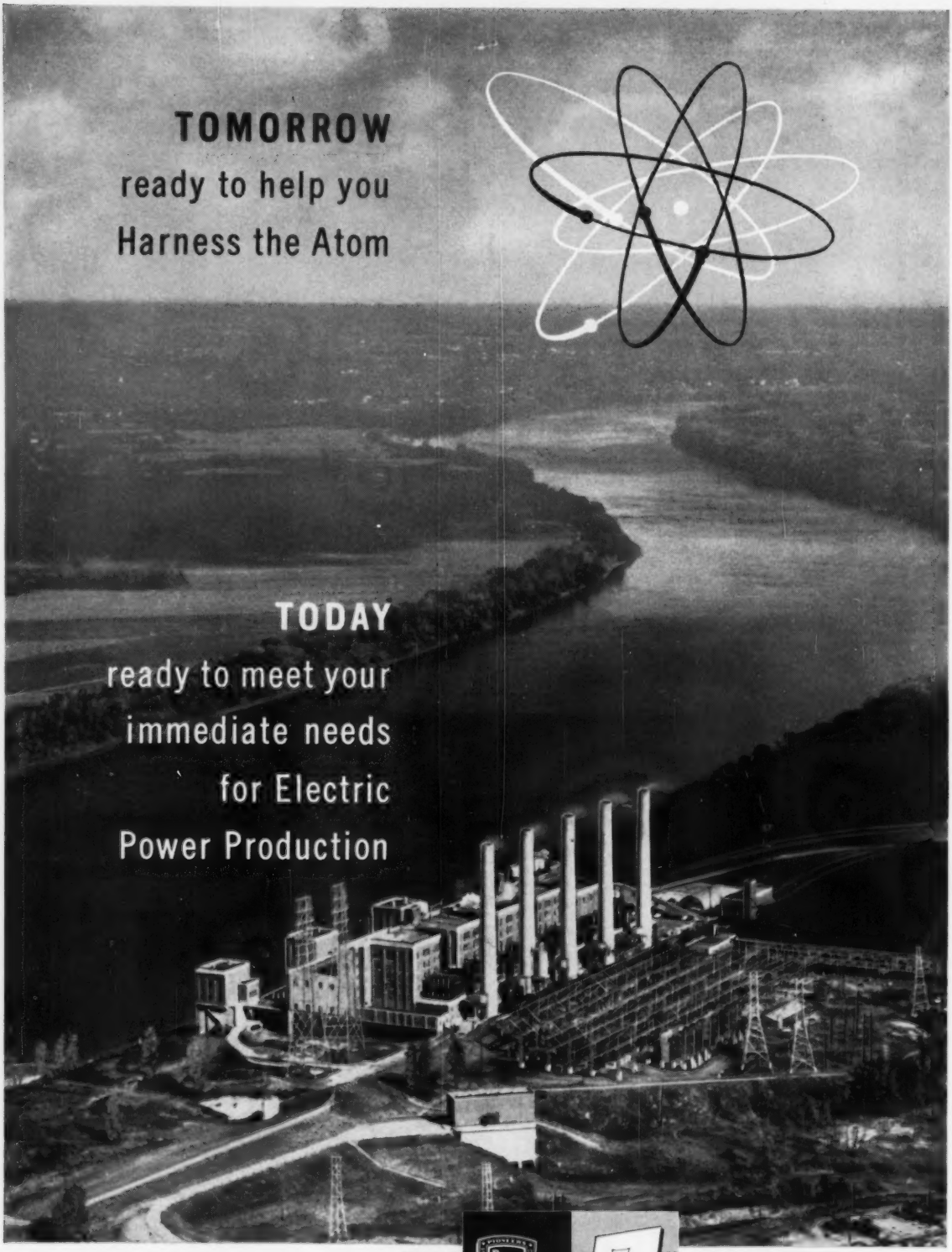
A BUTYL COMPOUND developed for high voltage insulation to insure superior resistance to ozone, heat and moisture. Manufactured under the most exacting standards to insure trouble-free operation.

BUTARONE insulation is rated at 85°C for voltages up to 17KV.

General Cable

. . . at your service!

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N.Y. Offices and Distribution Centers Coast-to-Coast



Pioneer Service & Engineering Co.

231 SOUTH LA SALLE STREET • CHICAGO, ILLINOIS

54 YEARS

Serving power plant needs of Industries and Utilities for 54 years.

Send for our descriptive booklet, "Pioneering New Horizons"

LOOK BEHIND THE "INSULATION CURTAIN" BEFORE YOU SELECT A LARGE MOTOR

Elliott puts the pressure on for complete penetration insulation treatment

Good insulation *material* alone is not enough! It takes a sound application process and real craftsmanship to do a 100% coil insulation job. That is why Elliott is not satisfied with just "coating" or spraying stator coils with insulation varnish. Instead every (600 v through 4800 v class) Elliott Squirrel-Cage Induction Motor coil is placed in a tank and evacuated to remove air, moisture or solvents from the coil itself. Next a carefully selected moisture and acid-resisting varnish is pumped under pressure into the coils to assure complete penetration and the filling of all voids by the varnish. It's a complete, foolproof filling and sealing job and *one big reason why* Elliott weather-protected motors have set a record of seven years of service from coast-to-coast, under all sorts of atmospheric exposure, *without one failure*. Ask your Elliott field engineer to give you complete facts on large motor insulation or write Elliott Company, Ridgway Division, Ridgway, Pa. for the Coil Insulation Bulletin.

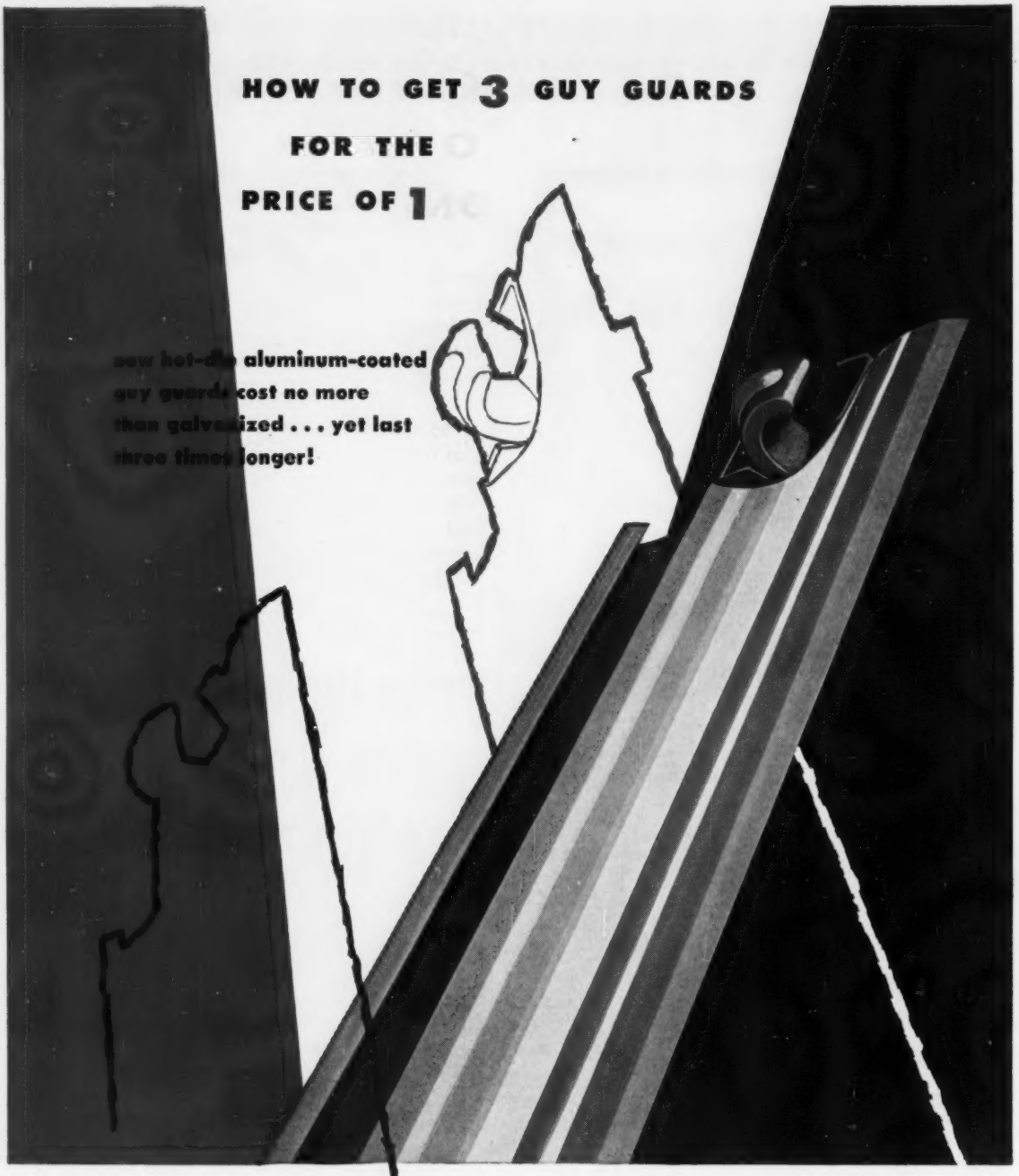
ELLIOTT WEATHER-PROTECTED MOTORS
Elliott squirrel-cage induction motors lead the field in insulation. Since 1948, out of 1,400,000 hp of motors with this insulation system, (installed in 42 states and 14 foreign countries) **not one stator coil has failed due to insulation breakdown or deterioration.**

RG-10

ELLIOTT Company

Elliott large motor insulation is "field-proven"

HOW TO GET 3 GUY GUARDS FOR THE PRICE OF 1



new hot-dip aluminum-coated guy guards cost no more than galvanized . . . yet last three times longer!

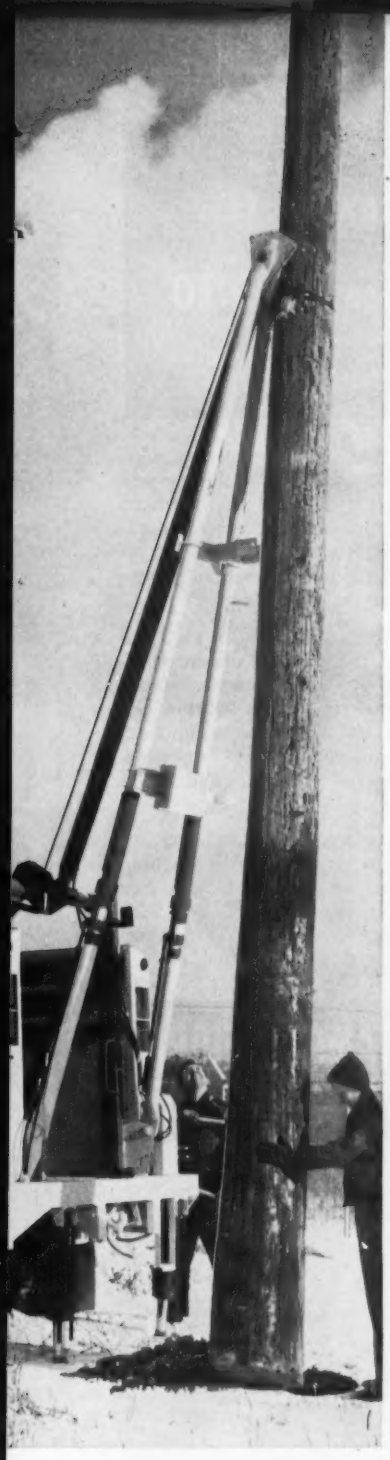
E-M

ELECTRICAL MANUFACTURING COMPANY
BATTLE CREEK, MICHIGAN

Designers and manufacturers of pole-line hardware that saves you time, money, and maintenance.
Prompt action on special problems.

Your own records will reveal that guy guards are items that need frequent replacing. Thus you can make substantial savings by standardizing on the new E-M ALUDUR® hot-dip aluminum-coated guy guards—for they last three times as long as galvanized. Their strength is the same, their price is the same, but they give three times the service life of galvanized. And they are half again more reflective! The ingenious E-M bottom clamp cuts installation time down to 30 seconds. A sample will be expressed to you without charge. Send your request today.

60



LIVE-BOOM DERRICK RISES TO THE OCCASION

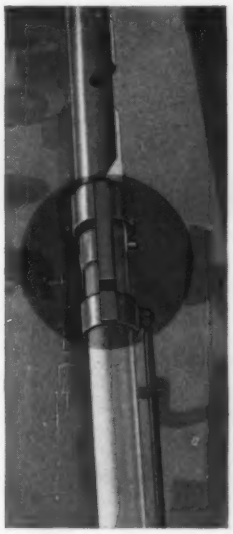
This 5700 Series Holan derrick literally rises to the job at hand. In a matter of seconds, smooth hydraulic power brings the derrick from out-of-the-way overhead storage into working position.

The derrick lifts poles 55 feet long, has an infinite number of lifting positions and gives live-boom action even with a single-drum winch. Its capacity: 6000 pounds . . . 2000 pounds for loading into the truck body.

To keep the derrick rigid, you can specify pin locking or Holan's exclusive hydraulic sleeve locking . . . completely automatic coupling of the side legs. Write for catalog on Series 5700 Power Derrick.

PIN-LOCK TYPE

Unique pin arrangement requires established sequence for locking the derrick. You can't pull out the wrong pin.



SLEEVE-LOCK TYPE

Operator pushes control lever and sleeve slides upward to lock derrick. Stop pins prevent the sleeve from accidentally disengaging.

Line construction bodies for light to heavy-duty. Crew compartments optional. Efficient tool compartments and drawers.

Aerial arm for spotting workmen 37 feet above ground, 9 feet below ground level. Rotates 360°.

Service bodies for chassis up to 1½ ton. Lengths, 72", 75", 84", 90" and 102".

Hydraulic Derricks designed for front or rear mounting. Capacities to 12,000 lbs.

Light-duty power operated derricks for front or rear mounting. Operating range of 146°.

Ladders to 40' with all phases completely hydraulic. Pump actuated by P.T.O. or separate engine drive with electric starter.

Mechanical Ladders expertly engineered and counterbalanced for effortless handling. Maximum heights from 23' to 40'. Swings 360°; angles to 72°.

Portable hydraulic and mechanical earth borers. Augers for 8" to 20" diameters, depth to 8'.

Wide variety of pole and reel trailers. Standard and special. Many optional features.

Hydraulic jacks, controlled from rear of truck. Rigid mounted or patented Holan self-stowing types.

Hydraulic towers with rotary, stationary, or transverse platforms. Exclusive box-girder telescoping mast.

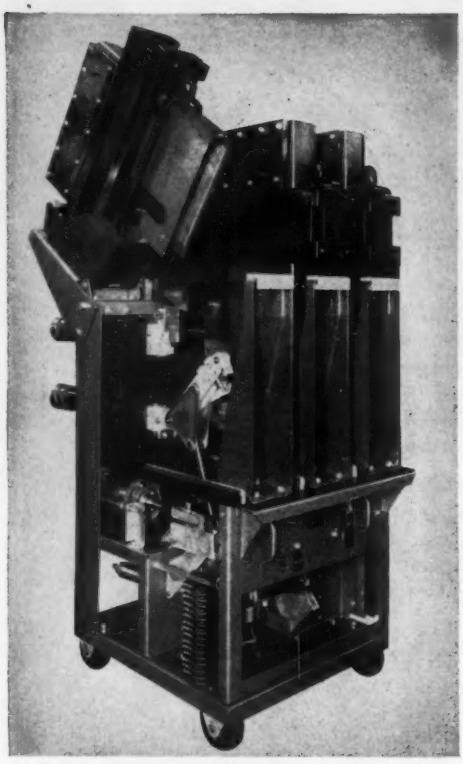
J.H. HOLAN® CORPORATION

4100 WEST 150TH STREET
CLEVELAND 11, OHIO

OTHER PLANTS:

HOLAN CORPORATION OF GEORGIA, Griffin, Ga. • J. H. HOLAN CORP., Phoenix Div., Arizona
BRANTFORD-HOLAN LIMITED, Brantford, Ontario

THE NAME THAT MEANS WORK SIMPLIFICATION



ROLLED AND MOLDED ARC CHUTE SHELLS, made by C-D-F for the I-T-E Circuit Breaker Company for 7.5 and 15 KV air magnetic circuit breaker, are good examples of paper-base Dilecto doing a hard job. Each completely closed insulating shell (NEMA grade X) has flame-retardant construction, negligible water absorption, and high dielectric strength at all points to withstand impulse test requirements.

High strength, low cost...

C-D-F paper-base Dilecto®

Excellent electrical properties, ease of machining and punching, with low costs are features of the many paper-base grades of Dilecto laminated plastics. Adaptable to forming, Dilecto is a mechanically versatile insulating material that withstands difficult operating conditions, moisture and temperature variations.

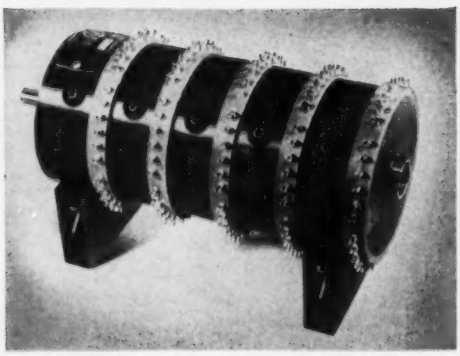
Insulating papers include kraft-alpha, cotton rag, and asbestos. Improved phenolic, or melamine silicone laminating resins are used. C-D-F builds flame resistance into a paper-base laminate—you get a worthwhile, easier-to-machine substitute for a glass-base laminate. C-D-F bonds copper uniformly to Dilecto — you get a superior metal-clad laminate for printed circuit applications.

A big, reliable source of supply, C-D-F helps you improve design, simplify purchasing, speed production. Look in C-D-F's catalog in the Product Design File (Sweet's) for the address of your nearest C-D-F sales engineer. Write for samples and new Dilecto catalog:

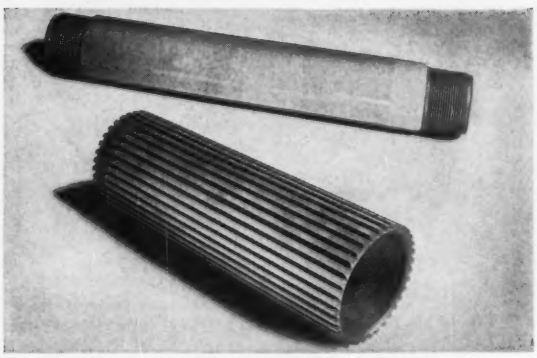
CONTINENTAL DIAMOND FIBRE

CONTINENTAL-DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.

NEWARK 15, DELAWARE



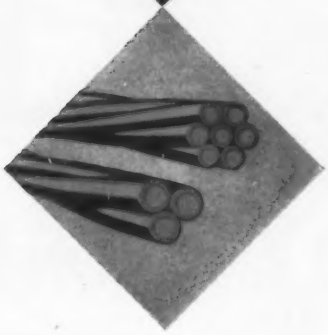
THIS HIGH-SPEED SAMPLING SWITCH, for missile telemetering and automation applications has a paper-base Dilecto tubing body. Materials engineers at General Devices, Inc., selected Dilecto "for its mechanical properties and low moisture absorption."



ACCURATE MACHINING, SMOOTH FINISHING are two merits of paper-base Dilecto. Note the perfection of milling cuts and threads! C-D-F has mass-production equipment, or can furnish sheets, tubes and rods with cost-cutting machining information.

From the day they're installed...

and throughout the entire life of the line...



Copperweld Guys give safe, strong support at lowest cost per year!

The permanent high strength of Copperweld* Guy Strand means permanent support for your overhead lines year-in and year-out. Guy repairs and replacements are eliminated once and for all. There's no doubt about it—the few extra pennies you pay for Copperweld Strand buy many extra years of dependable guying service. Why not start using Copperweld now—and save on upkeep every year for the life of your lines.

*Trade Mark

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION
Glassport, Pa.
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

Copperweld
TRADE MARK
non-rusting GUY STRAND

***The Best** in Terms of Safety and Service!*

FEDERAL PACIFIC'S
YVH AIR SWITCHES
OFFER YOU...

"Built-in" Dependability

FPE
FEDERAL PACIFIC ELECTRIC

DESIGN simplicity plus quality features insure outstanding performance!

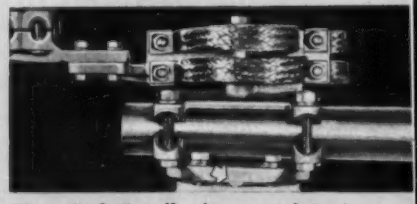
Simple: A basically simple, but highly efficient design, engineered to insure continuous, trouble-free operation.

Easy to adjust: Cut-and-try eliminated! Only two steps for a completely adjusted switch unit.

Easy to install: Lighter weight; shorter overall lengths; blades counter-balance each other.

Easy to operate: Engineered to provide mechanical advantages in and near the closed position. Stainless steel pins, and ball-and-socket connections.

Federal Pacific YVH outdoor group-operated rotating-insulator center-break air switches are available for horizontal, underhung or vertical mounting in 46, 69, 115, 161, and 220 kv sizes; 600 and 1200 amp continuous ratings; 20,000; 40,000 and 61,000 amp momentary ratings; ASA and NEMA standards. For complete details write for Catalog No. 4-142: Pacific Electric Switchgear Division, 5815 Third Street, San Francisco 24, California.



Hinge-End Detail: Arrow points to single-line rocker support. Selective tightening of cap bolts on each side of rocker provides complete alignment of contacts.

Contact Detail: High pressure is applied by beryllium-copper cantilever spring leaves.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC
COMPANY

50 Paris Street, Newark 1, N. J.

new FEDERAL PACIFIC TYPE AJ-54 oil circuit breaker

69kv, 2000 amp,
3500 and 5000 mva
5-cycle interrupting time
20-cycle reclosing time

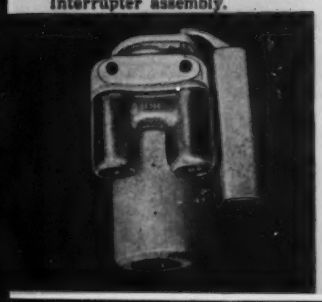
for heaviest duty at 69 kv

ASA AND NEMA STANDARD

Arcing contacts and the 2 sets of load contacts—after removal of chambers.

Moving-contact assembly.

Interrupter assembly.



A semi-portable, compact, skid-mounted circuit breaker . . . shipped completely assembled, tested and ready to operate.

For protection of large 69-kv systems so they may keep pace with load growth, yet retain the advantage of simplified bus schemes and minimum use of current-limiting reactors.

Better because . . .

Improved expulsion interrupters — simple, 6-shoe sliding contacts; load-break and arcing-break are widely separated; no critical closed-position adjustment; no charged springs within interrupters.

Oil-hydraulic accumulator-type operating mechanism eliminates need of removing moisture and frost from lines . . . also unusually complete use of hydraulics significantly improves circuit breaker performance.

Direct-line drive — main opening springs on end of pull rod; kick-off springs at each pole.

Emergency manual closing—always at full speed and under full force.

. . . and many other big features.

For complete details write: Pacific Electric Switchgear Division, Federal Pacific Electric Company, 5815 Third St., San Francisco 24, California.

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

COMPANY

50 Paris Street, Newark 1, N. J.

FPE
FEDERAL PACIFIC ELECTRIC

FPE
FEDERAL PACIFIC ELECTRIC

Federal Pacific Type DST Magnetic Air Circuit Breaker

offers fastest arc interruption of its class

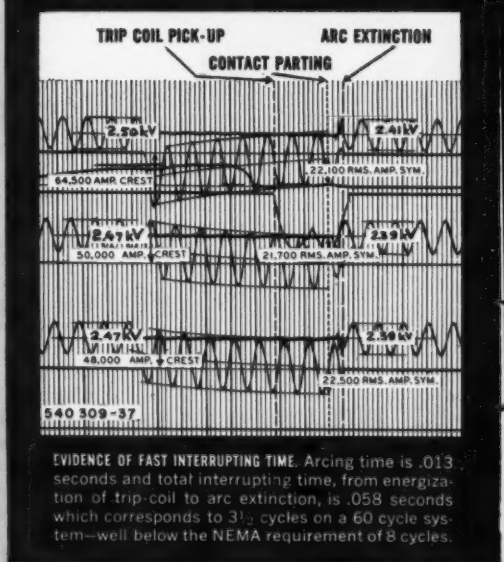
with SOLENARC principle of arc elongation!

The Federal Pacific Type DST Magnetic Air Circuit Breaker features exceptionally quick arc interruption secured through the Solenarc principle of arc elongation—a new and more effective means of extending and cooling the arc.

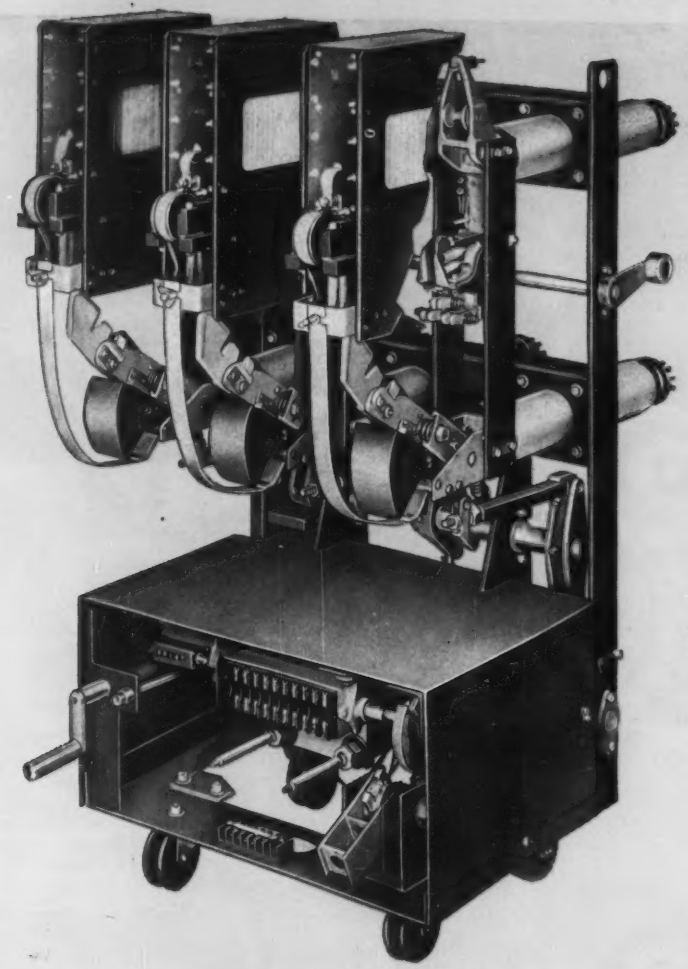
This principle utilizes a self-energizing magnetic field created by the solenoidal arc path to extend the arc rapidly to the point of interruption. Since the arc path is in effect an air core magnet, the magnetic field increases proportionately to the current without saturation.

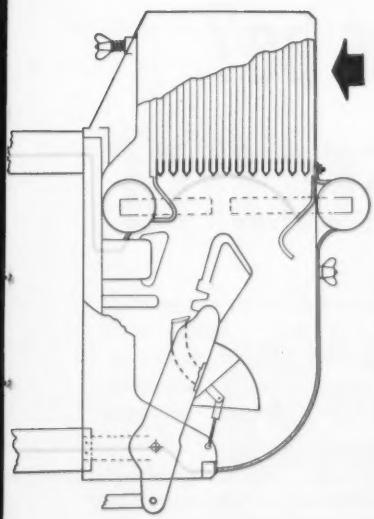
In addition to arc elongation, cooling plays an important part in effecting interruption. Each loop of the arc, expanding between ceramic separating plates, sweeps over the entire surface of the relatively cool plates; thus fully utilizing their cooling properties.

The combined effects of rapid arc elongation and more efficient cooling results in extremely rapid arc interruption as indicated in typical oscillogram re-presentation shown.



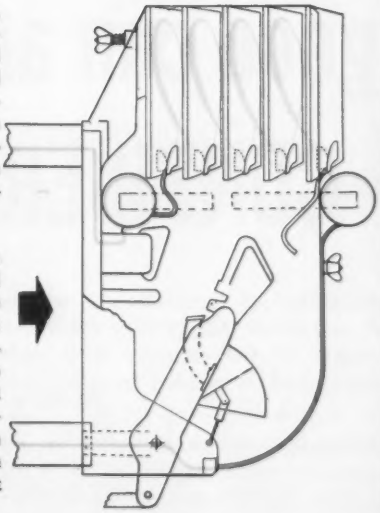
EVIDENCE OF FAST INTERRUPTING TIME. Arcing time is .013 seconds and total interrupting time, from energization of trip-coil to arc extinction, is .058 seconds which corresponds to 3½ cycles on a 60 cycle system—well below the NEMA requirement of 8 cycles.





As contacts separate, the arc is transferred to the arcing horns, inserting the two magnetic blow-out coils into the circuit and creating an intense magnetic field which forces the arc rapidly upward. The apex of the arc is shown entering the arc interrupting chamber at which point it is sub-divided into segments between the conducting elements.

The arc segments move upwards between the chamber plates and are formed into loops. As these loops expand outward, under the influence of a self-created magnetic field, the arc is increased to many feet in length. As a result of the rapid increase in arc resistance caused by arc elongation and cooling, circuit interruption takes place at or near the first current zero.



Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

COMPANY

50 Paris Street, Newark 1, N. J.

CAREFUL INSPECTION of shells immediately after forming is only one of 77 control procedures and tests involved in the production of MICRO-GLAZE® Suspension Insulators — your assurance of dependable service.

How good can an insulator be?

CONSIDER THE EFFECT OF

The dependability of insulators — whether suspension, apparatus, pin type or other — is related directly to the *accuracy* with which each insulator shell is molded from extruded clay.

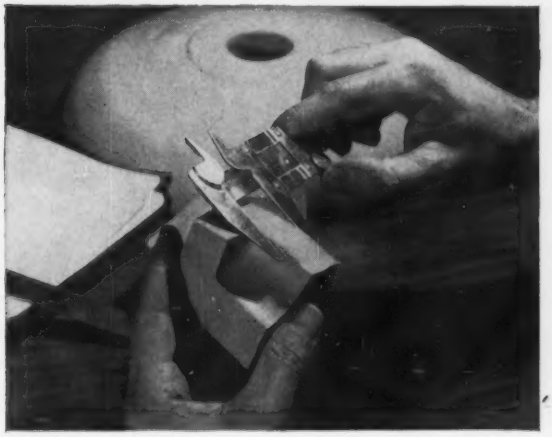
Ultimate values of flashover, dielectric strength and mechanical strength depend on exact configuration. Even slight variation in any dimension, might reduce the high degree of safety built into each unit. To be certain the dimensions of your insulators conform to engineering specifications, Locke not only inspects each formed shell visually, but also spot-checks internal dimensions on a routine basis. Any variation from standard shell contour is cause for rejection.

The case of Shell Formation "Quality Control" is typical of the extremes to which Locke goes to assure trouble-free insulator service on your system.

For a brief and complete picture story of insulator quality control, just call your Locke representative.

PERMANENT BONDING of caps and ball bolts to the finished suspension insulator shell is possible only with a good fit. Here the head sliced from a typical shell is carefully checked for proper diameter (A—outline below).

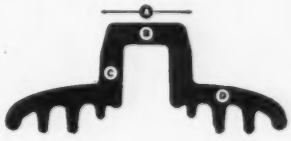
RESISTANCE TO PUNCTURE of the finished suspension insulator depends largely on the thickness of porcelain separating cap and ball bolt. This head thickness (B) is subject to constant inspection.



OVERALL STRENGTH is assured by constant checking on wall thickness (C) across two diameters. By making sure that these measurements are equal, eccentric forming and possible structural weakness are avoided.

MAXIMUM FLASHOVER STRENGTH and full leakage distance are maintained by rigid control of corrugation size (D). Frequent spot-checks assure proper forming.

SHELL DIMENSION



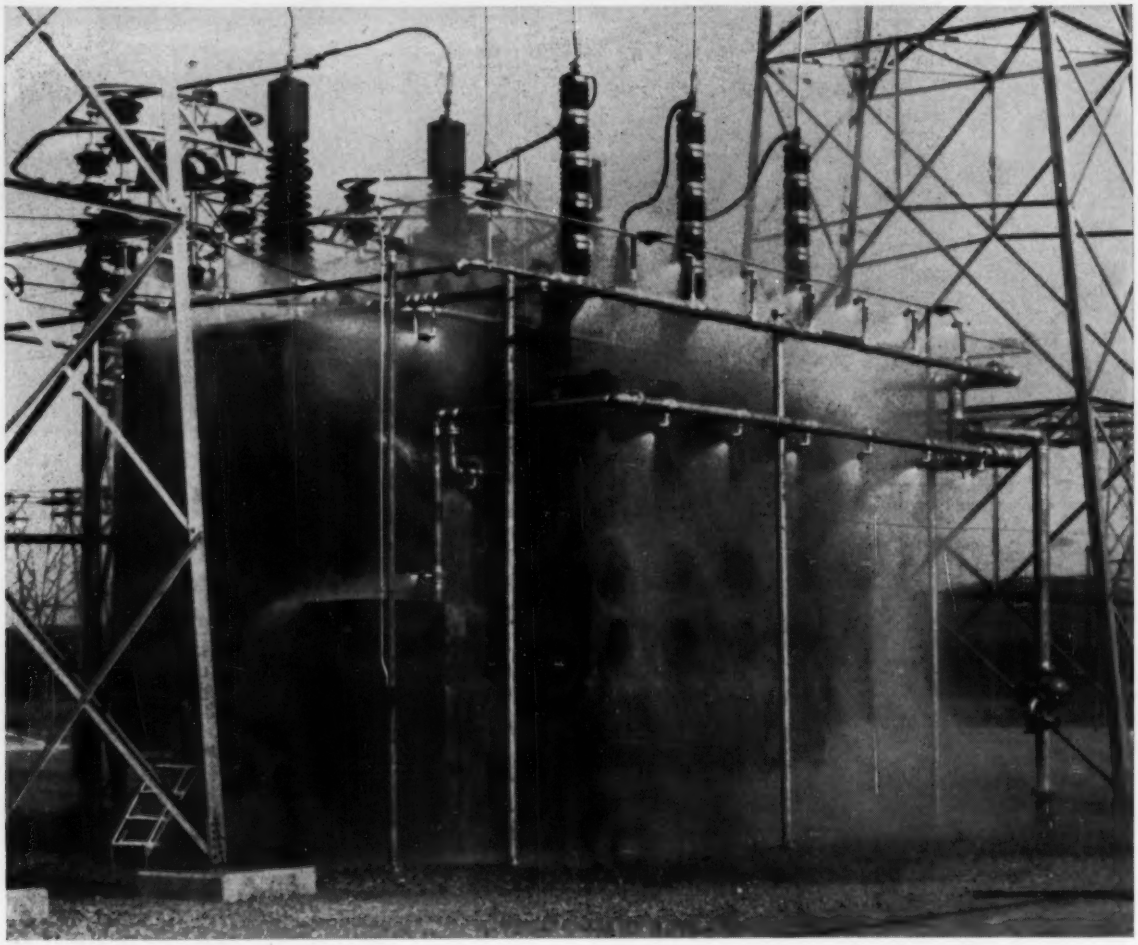
LOCKE

LOCKE DEPARTMENT
GENERAL ELECTRIC COMPANY
BALTIMORE, MARYLAND

Performance Protected by

77 POINT
QUALITY CONTROL

*Trademark of General Electric Company



...give your equipment the best fire protection

a BLAW-KNOX automatic FOG SYSTEM

Engineered to give your transformers and other equipment positive protection against fires, a BLAW-KNOX *Automatic* FOG SYSTEM goes into action immediately:

- *smothers flames*
- *dissipates heat*
- *protects adjacent equipment*
- *prevents loss of revenue*
- *prevents service stoppage*
- *avoids customer complaints*

"Little Joey Sprinkler" always on the job

Why not give your equipment the BEST possible protection? Let a Blaw-Knox *fire-protection* Engineer study your needs. He will gladly submit a layout and a cost estimate . . . with no obligation to you.

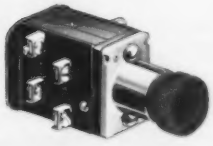
A BLAW-KNOX Automatic FIRE PROTECTION SYSTEM for EVERY NEED.

50th Anniversary
BLAW-KNOX
1906-1956

BLAW-KNOX COMPANY

Automatic Sprinkler Department/Pittsburgh 33, Pennsylvania

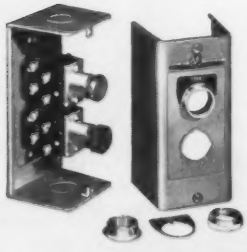
ALLEN-BRADLEY
HEAVY DUTY PUSH BUTTONS



Bulletin 800 heavy duty STOP button ready to mount in enclosure. (See below)

These new Bulletin 800 heavy duty push buttons are the modernized version of that old reliable line of A-B heavy duty stations. Advantages—until now restricted to the oiltight stations for machine tool use—have been built into these new heavy duty stations—and you'll like the result.

For instance, each button or pilot light is a self-contained unit which can be mounted singly or in groups—vertically or horizontally—in a variety of standard Allen-Bradley enclosures, with the name plate reading in the right direction. Double break, silver alloy contacts used throughout. Send for Bulletin 800.



A small stock of standard components lets you assemble any special heavy duty station. There is no waiting for special push button stations.

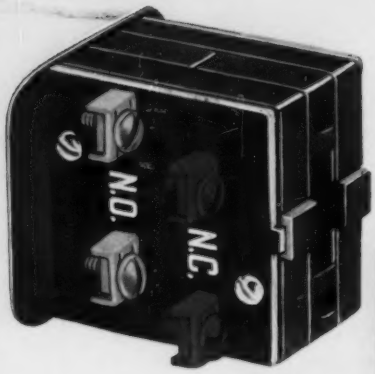
5-56-MR

Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wisconsin

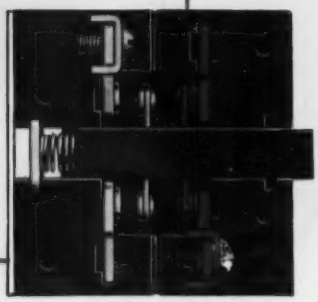
In Canada
Allen-Bradley Canada Ltd., Galt, Ont.

A-B Quality

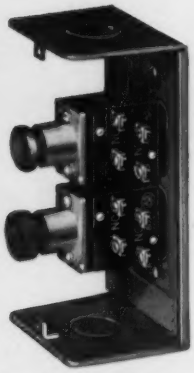
ALLEN-BRADLEY
QUALITY
BULLETIN 800 PUSH BUTTONS



Left—External view of contact block showing N. O. & N. C. terminals.

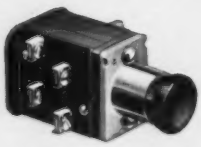


Right—Internal view of contact block showing double break N.O. & N.C. stationary contacts. The pushrod carries the moving contacts.

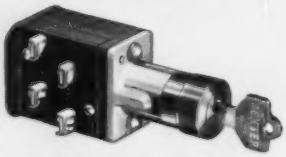


Two button station with name plate and clamping ring removed from cover.

A NEW LINE OF ALLEN-BRADLEY HEAVY DUTY PUSH BUTTONS

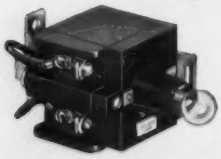


Type AK1B flush head START button



Type EK11B cylinder lock unit

Type HK11B wing lever selector switch unit



Type PK16 pilot light with 110 v, 60 cy. transformer. Available with 220-440-550 v, 60 & 25 cy. transformer

Allen-Bradley heavy duty push buttons have been redesigned to take advantage of the type of construction that has made A-B oiltight machine tool stations so popular.

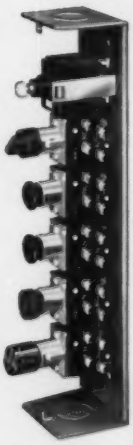
While the new Bulletin 800 heavy duty line is not oiltight, it uses contact blocks that have proved so dependable in the Bulletin 800T oiltight push buttons. Special heavy duty stations can be assembled on the job from a small stock of standard components.

Several types of operators are available, such as standard head, mushroom head, coin slot, key type, wing lever, and 2 or 3 position selector switches. The buttons can be supplied in different colors.

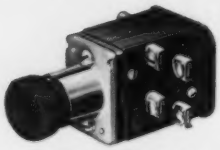
These push button stations can be easily arranged for either vertical or horizontal mounting —with the name plates reading correctly for the desired mounting.

Standard enclosures accommodate up to 8 buttons and pilot lights. Enclosures for more than 8 units can be supplied. Write for Bulletin 800.

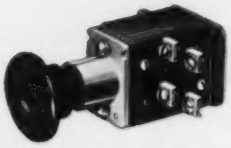
Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.
In Canada
Allen-Bradley Canada Ltd.
Galt, Ont.



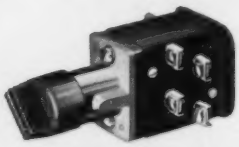
Five button station with pilot light



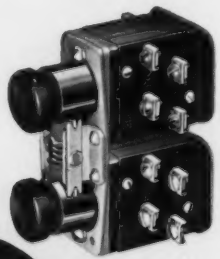
Type BK6B ext. head STOP button



Type DK6B mushroom head button



Type HK2B selector switch



Type FK2B 2 button interlocked station

ALLEN-BRADLEY
MOTOR CONTROL

5-56-MR

*

Sales Feature . . . **Uniform Heat**

The entire surface of our panel radiates heat.

Sales Feature . . . **Economy**

Efficiency up to 80% means minimum operating cost—makes electrical heating practical for large areas.

Sales Feature . . . **Safety**

No glowing wires or coils—and there's no water needed. PYREX brand glass is strong.

Sales Feature . . . **Cleanliness**

Corning panels don't attract dust—have no combustion waste.

Sales Feature . . . **Comfort Control**

Each room can have the amount of heat it needs right to the degree.

Sales Feature . . . **Fast Heat**

Corning panels radiate infrared rays that convert to warmth fast.

Sales Feature . . . **Silence**

No moving parts.

Sales Feature . . . **Space Saving**

A complete unit need be only 2 or 3 inches deep.

Sales Feature . . . **Easy Installation**

You can design heaters with Corning Radiant Panels for installation with no complicated wiring or wall preparation.

Sales Feature . . . **Pre-Acceptance**

Consumers know that the PYREX trade-mark identifies dependable value. This helps you gain high acceptance with a new product — right from the start—with consumers, dealers, distributors.

PYREX E-C panel's sales features are helping to create wider acceptance for electric heating

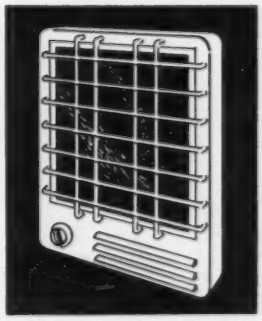
Take all the reasons for having electric heat. Add to them the sales features of the PYREX E-C panel.

You'll have a doubly-impressive collection of features to build demand for electric heat installations in new homes . . . additions . . . expansions . . . auxiliary heating . . . emergency heating . . . and portable heating.

The PYREX E-C panels supply the sales edge in the way they perform. We make them of a PYREX brand glass with a conductive, metal oxide coating bonded to the back surface. They emit infrared energy with a high degree of efficiency. They're mechanically strong and thermally rugged. And their electrical characteristics are excellent. They can be used as high temperature, 2,000- and 3,000-watt units for permanent space-heating installations. Also current surge on starting is low.

To learn all about Corning PYREX E-C Panels and how you can use them to increase the use of electric heating, write, wire or phone Corning Glass Works.

If you are interested in using these PYREX E-C panels as components in new heaters, we'd be delighted to talk it over with you.

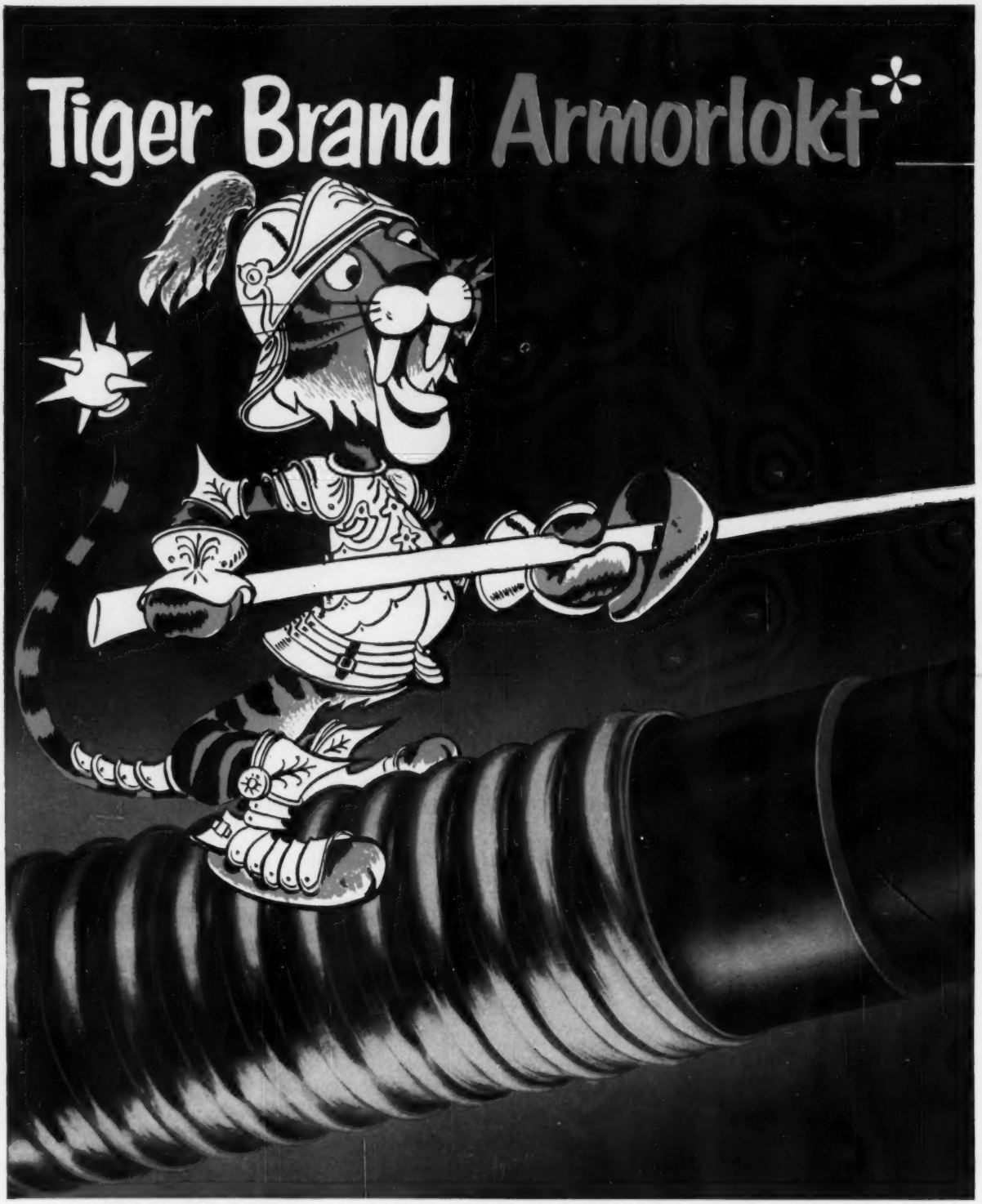


Standard panel sizes: 8" x 36", 12" x 16" and 16" x 24" are available. Other sizes to order.

CORNING GLASS WORKS, CORNING, N. Y.

39-6 Crystal Street

Corning means research in Glass



SEE US AT THE
NAED CONVENTION
JUNE 10-14

interlocked armor cable

USS

UNITED STATES STEEL

now available up to 4″ core diameter

TO meet the demand for larger sizes, Tiger Brand Armorlokt cable is now being made in sizes up to four inches core diameter. Armor can be made from either galvanized steel or aluminum.

Tremendous installation savings are available with these larger sizes of Tiger Brand Armorlokt. The assembly weighs only about 1/3 as much as standard conduit/cable methods. There is no costly conduit bending and fitting. Splices can be made *anywhere* along the cable's length—and quickly, too.

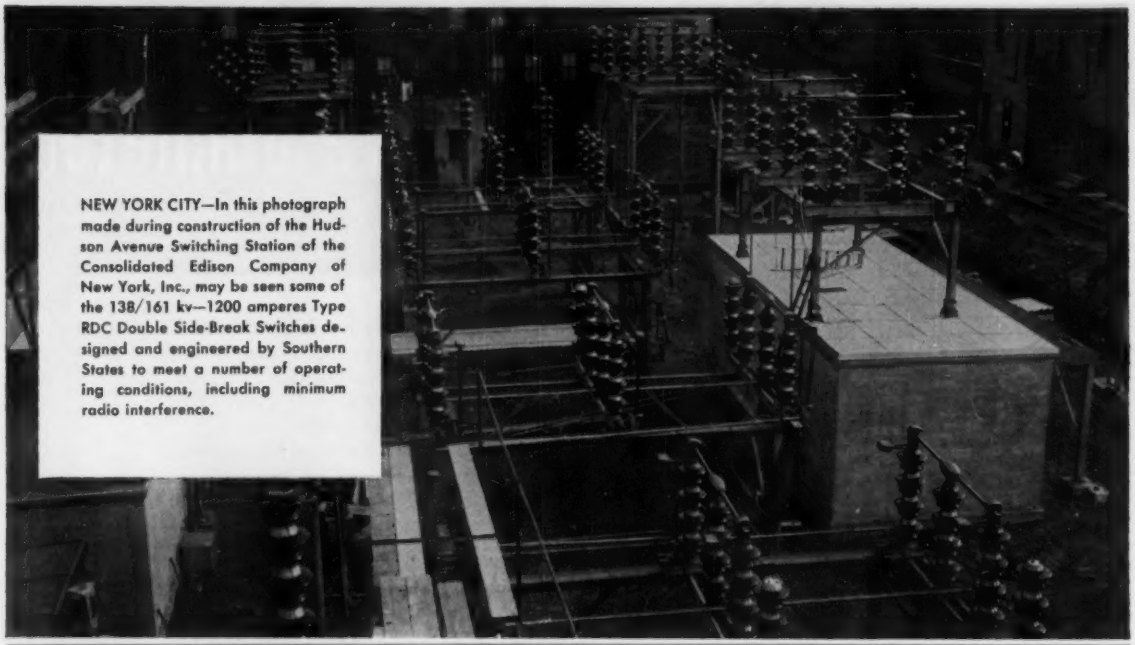
Just call your nearest American Steel & Wire representative.

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB!

- asbestos wire and cable
- mold cured portable cord
- aerial, underground and submarine cable
- shovel & dredge cable
- paper & varnished cambric cable
- machine tool & building wire
- special purpose wire & cable

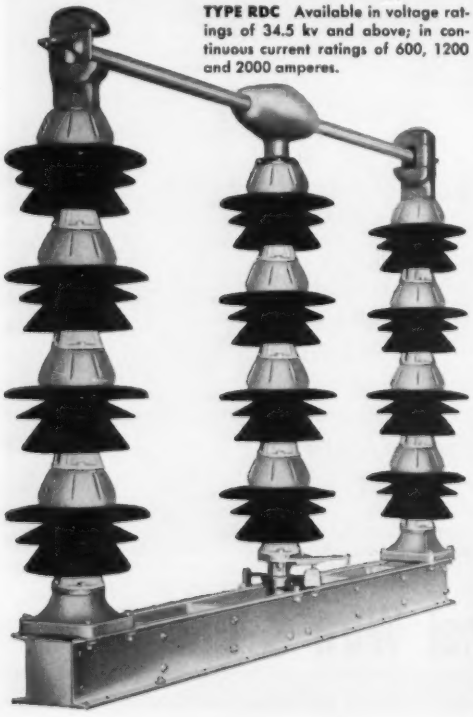
AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS Tiger Brand Electrical Wire & Cable



NEW YORK CITY—In this photograph made during construction of the Hudson Avenue Switching Station of the Consolidated Edison Company of New York, Inc., may be seen some of the 138/161 kv—1200 amperes Type RDC Double Side-Break Switches designed and engineered by Southern States to meet a number of operating conditions, including minimum radio interference.

Consolidated Edison Picks Type RDC Switches For its Hudson Avenue Switching Station



TYPE RDC Available in voltage ratings of 34.5 kv and above; in continuous current ratings of 600, 1200 and 2000 amperes.

The newest member of Southern States' complete line of air break switches was chosen by Consolidated Edison for its recently completed Hudson Avenue Switching Station.

The Type RDC has an RIV of less than 500 microvolts, a primary requirement for this station located in Brooklyn, New York.

There are many other advantages of this double side-break switch, including:

- **High momentary current rating**
- **Streamlined, corona-suppressing contours**
- **Minimum number of current interchange points**
- **Shuntless design**
- **Wide angle blade rotation**
- **AMPLITACT® silver-to-copper contacts**
- **Shielded mechanisms—complete icing protection**
- **Greaseless, non-corroding ball bearings**
- **Switch blade is one continuous member**

Your Southern States representative will be glad to give you more information about this new switch.

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

Cut-away of The Dalles Dam power house. Artist's rendition courtesy of Portland District, Corps of Engineers, U.S. Army.

Runner of the Kaplan turbine is 280" in diameter.

The Dalles Dam gets biggest Kaplan turbines

Deliveries have now begun on an order covering 14 BLH Kaplan type turbines for The Dalles Dam on the Columbia River.

These are the most powerful adjustable blade propeller type turbines ever built. Each is rated to deliver 123,800 hp at 85.7 rpm under 81 foot head. The power plant will eventually house 22 turbines with total rated capacity of 2,723,600 hp. BLH is also furnishing the station service units and governors.

BLH is the recognized leader in hydraulic turbine research, design and manufacture. For a copy of our illustrated bulletin 1001, write to BLH Corporation, Philadelphia 42, Pennsylvania, or Dept. 5107, Pelton Division (BLH), 2929 Nineteenth Street, San Francisco 10, California.

BALDWIN · BLH · LIMA-HAMILTON

EDDYSTONE DIVISION
BALDWIN-LIMA-HAMILTON

DIVISIONS: Austin-Western • Eddystone • Electronics & Instrumentation • Hamilton • Lima • Loewy-Hydropress • Pelton • Madsen • Standard Steel Works

Wagner TRANSFORMERS . . . the choice of leaders in industry

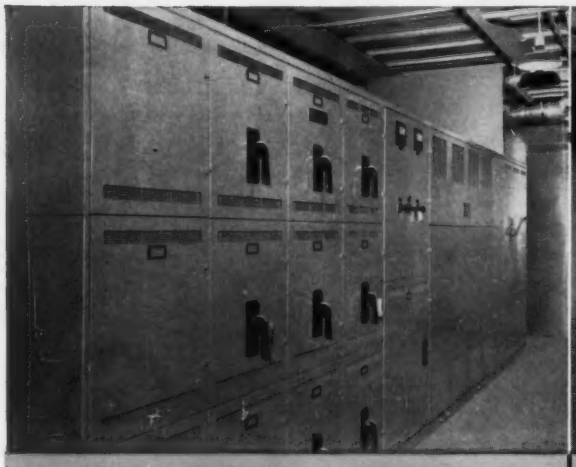
Wagner Unit Substation Transformers supply

At IBM's new printed-circuit and electric typewriter plant at Kingston, New York, electricity and automation work together to increase output per manhour and to increase output per unit of plant area. The factory itself is the latest in modern manufacturing plant design and utilizes the modern load center scheme of in-plant electrical distribution. This method of secondary distribution brings power at high primary voltages close to the load to reduce voltage drop and conductor losses.

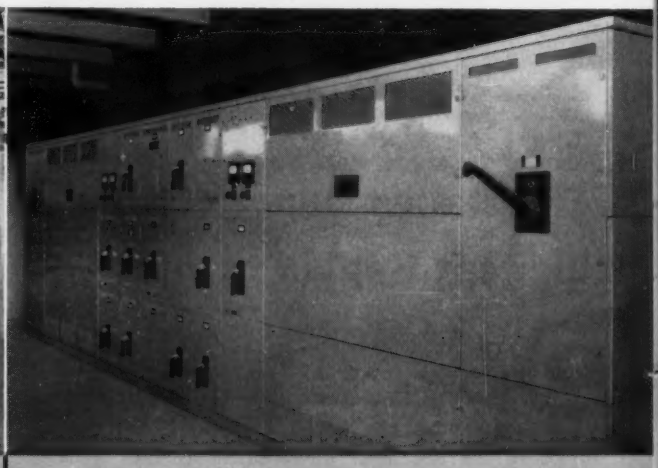
The unit substations in this plant are equipped with Wagner dry-type Transformers.

Wagner pioneered in the development of dry-type load center transformers, and the Wagner design is known for its great mechanical strength and electrical stamina. Wagner dry-type Transformers are carefully engineered to meet heavy industrial demands —built to stand up under rigorous twenty-four hour a day production schedules.

Wagner unit substation transformers can answer your power needs just as they do at IBM. Choose Wagner for your next load-center installation. Consult the nearest of our 32 branch offices or write for Bulletins TU-205 and TU-214. They give full information on Wagner Unit Substation Transformers for industrial power distribution systems.



This 1000 kva Unit Substation at IBM's Kingston plant is equipped with a Wagner dry-type load center transformer to deliver 480 volt three phase power to large machines and equipment.

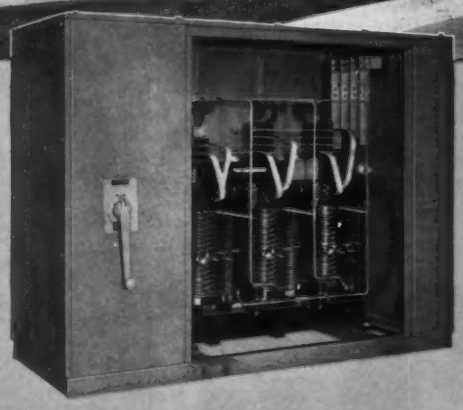


IBM uses this 500 kva double-ended Wagner-equipped unit substation to supply 208Y/120 three phase power, for lighting and small power loads.

There's a Wagner Substation Transformer
PREDESIGNED **to meet your load-center needs**

Wagner Unit Substation Transformers are *"Predesigned"*. They are built in standard ratings which are coordinated with the specifications of unit substation builders. This completely eliminates individual job engineering—saves time—reduces costs. You get a proven design in a completely assembled and tested transformer—and get quick delivery.

Why not check up now on the adequacy of your transformers? If you find that new units or a new load center distribution system is in order—Wagner can supply you with substation transformers *predesigned* to meet your requirements.



Wagner dry-type transformers for power distribution are available in single-phase, 1 through 500 kva; and 3-phase, 3 through 2000 kva ratings.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave. • St. Louis 14, Mo., U. S. A.

T56-10

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

YOU GET

LONG-LASTING PROTECTION FOR YOUR OVERHEAD SYSTEM

with

BLACKBURN *Grounding* DEVICES

Type GTC 1
One plate tower ground clamp

Type GTC 2
Two plate tower ground clamp

Copper Bonded Pigtail

Type GUV
U-bolt ground clamp parallel or 90°

Steel Driving Stud for Sectional Ground Rods

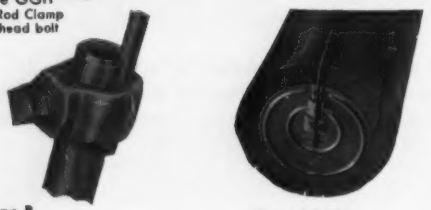
Type GG
Ground Rod Clamp
Socket set screw

Copper Alloy Coupling for Sectional Ground Rods

Copper Bonded Sectional Ground Rods

Copper Bonded Regular Ground Rods

Type GGH
Ground Rod Clamp
Square head bolt



Type B
Budget Line Ground Rod Clamp
Square head bolt

Type GP 100
Electrolytic Copper Pole Bottom Plates
7½", 10", 14" dia.

Blackburn grounding devices will save you thousands of dollars annually in preventing burnouts of expensive overhead equipment. This complete line simplifies your stocking problem—one source for all your needs. Like all BLACKBURN products they are constructed of high-strength corrosion resistant materials—designed for easy installation and engineered for long-lasting, trouble-free grounding. Always specify BLACKBURN.

Available Through Electrical Wholesalers Everywhere

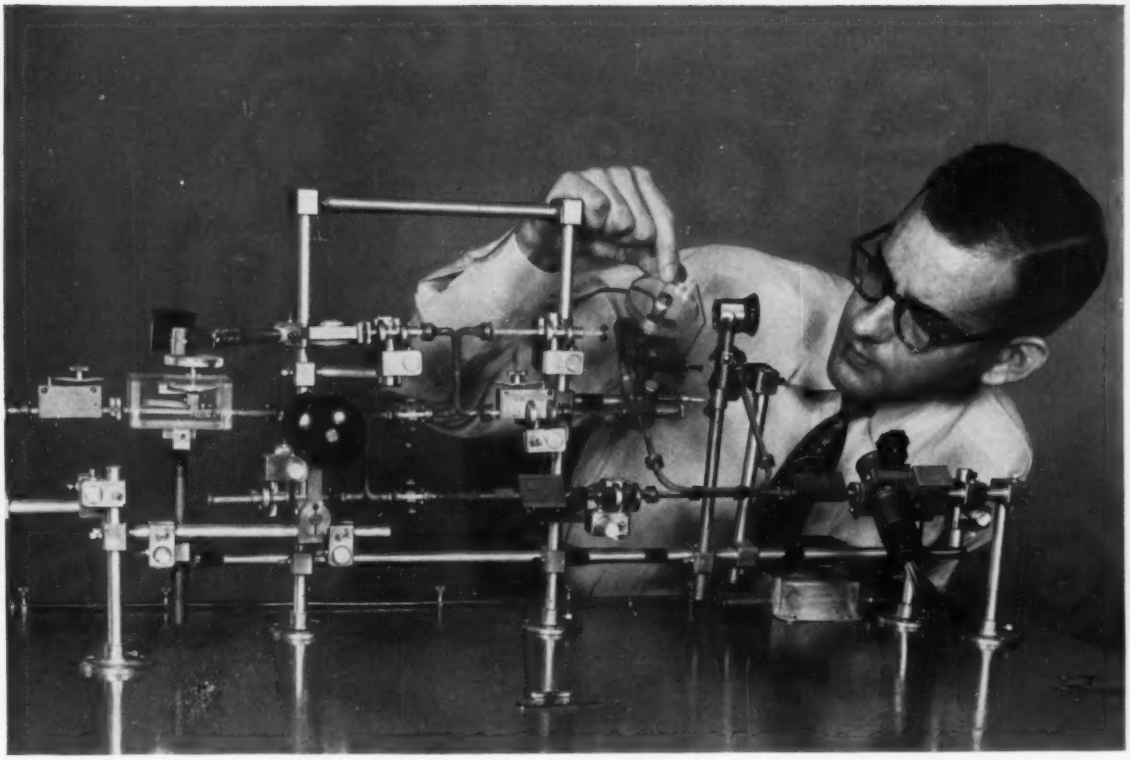
DISTRIBUTED ON THE WEST COAST BY

KORTICK MFG. CO.

JASPER BLACKBURN CORPORATION

ST. LOUIS 6, MO.

35 Madison Street — Phone MAin 1-2821



Physicist G. K. Farney checks the frequency of Bell's new klystron, which is located at far right. Tube's output is about 20 milliwatts.

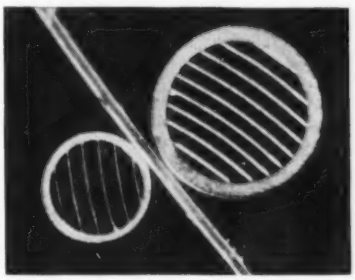
Sixty billion vibrations per second

A great new giant of communications—a waveguide system for carrying hundreds of thousands of voices at once, as well as television programs—is being investigated at Bell Telephone Laboratories.

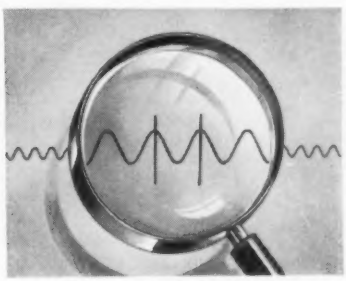
Such a revolutionary system calls for frequencies much higher than any now used in communications. These are provided by a reflex klystron tube that oscillates at 60,000 megacycles, and produces waves only 5 mm. long.

The resonant cavity that determines the frequency is smaller than a pinhead. The grid through which the energizing electron beam is projected is only seven times as wide as a human hair, and the grid "wires" are of tungsten ribbon 3/10,000 inch in width.

G. K. Farney, University of Kentucky Ph. D. in nuclear physics, is one of the men who successfully executed the development of the klystron. Dr. Farney is a member of a team of Bell scientists whose exciting goal is to harness the immense bandwidth that is available with millimeter waves . . . and to make certain that your telephone system remains the best in the world.



Grids in new tube, enlarged 30 times, with human hair for comparison. Electronic beam passes through smaller, then larger, grid.



Wavelengths produced by the klystron tube are only .2 inch long—1/15 that of the transcontinental radio relay system.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH

Aluminum Cable?

ANACONDA IS READY WITH THE BROADEST LINE IN THE INDUSTRY

At Anaconda, only the metal is different—service and quality are the same, whether you specify copper or aluminum.

So let Anaconda meet your aluminum needs with...

1 Broadest line of aluminum conductors in the industry including bare aluminum and ACSR; Neoline*, Polene* and Duraline* line wire; Types SE, SD, N-SD and K service cables; aerial power cable; network cable; cathodic protection cable; and many others.

2 Seven-mill service. Anaconda has more mills producing aluminum wire and cable than any other manufacturer. Seven fabricating mills strategically located across the country assure speedy service.

3 Electrical Distributors. Anaconda Wire & Cable Company has several hundred electrical distributors located throughout the country who can expeditiously provide you with Anaconda products.

4 Reduction plant at Columbia Falls, Montana, gives Anaconda control over its aluminum production from reduction of alumina... to wirebar... to rod... to finished product.

5 Insulated-cable experience—in design, research, construction and quality control—helps Anaconda produce aluminum wire and cable with superior electrical and physical characteristics.

6 Technical assistance. Anaconda field engineers have worked in advisory capacity on hundreds of complex jobs. They are ready to put their experience and knowledge to work on your problem.

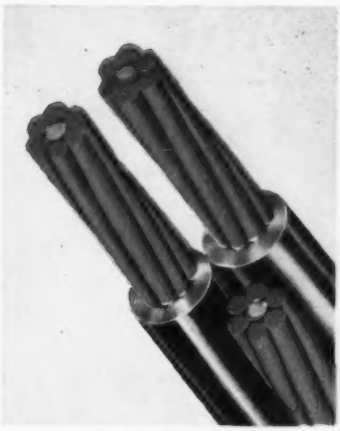
The Man from Anaconda will be happy to help you. Backed by the broadest line of wire and cable in the industry in both copper and aluminum, he is best qualified to help you arrive at the most practical and economical answer to your cable needs. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U. S. Pat. Off. 56304

ASK THE MAN FROM

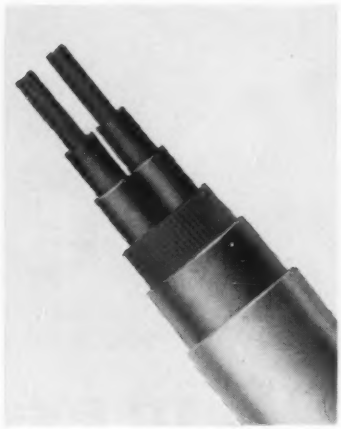
ACSR

Bare all aluminum



Type N-SD service drop

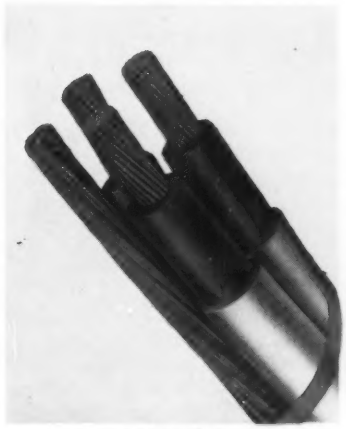
Type K service drop



Silvaline* Type SE service entrance

Duraline weatherproof line wire

Neoline* and polyethylene line wire



Aerial cable

Type CP cathodic protection cable

ANACONDA®

FOR ALUMINUM WIRE AND CABLE

the P&K story

HIGHWAYS

DRIVE-INS

BETTER LIGHTING everywhere

SHOPPING CENTERS

PARKING AREAS

RECREATION AREAS

AT LOWER COST to everybody

Pfaff & Kendall, originator of the Seamless Tapered Aluminum Lighting Standard and Tapered Elliptical Arm, is now producing designs and types to meet any highway, road, area, bridge and traffic signal requirement.

Wherever P & K All-Aluminum Standards and Brackets are specified and installed, the story is the same: *Fewer technical problems . . . rapid, easy installation . . . greater lighting efficiency . . . and the kind of economy you can figure in actual dollars!*

P & K All-Aluminum Standards and Brackets are always the wisest choice . . .

LIGHT WEIGHT for lowest cost installation.
NEGLIGIBLE CORROSION for longest service.
NO PAINTING means large, year-after-year savings.
SALVAGEABLE, RE-USABLE in event of knockdown.

WRITE FOR LATEST P & K CATALOG... and use the P & K planning and advisory services without obligation.

Pfaff & Kendall
84 Foundry Street
Newark 5, New Jersey

LONG LIFE OF YOUR TRANSMISSION LINES depends on insulator characteristics—and *uniformity* of those characteristics. The experience of millions of Lapp suspension units in service proves the soundness of Lapp design. Automation and control in Lapp manufacture guarantee their uniformity—and their low cost to you, in terms of mechanical strength, electrical permanence, and extra margin of operating security.

Lapp

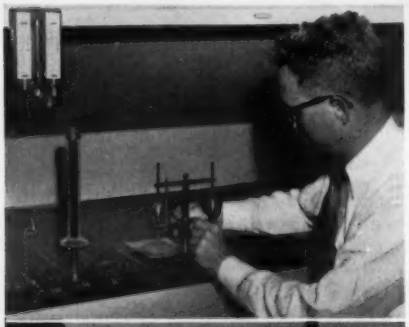
THEY START ALIKE so that they will perform alike on your lines. These are pugs of plastic clay, chunks that will finally be Lapp suspension insulator discs. Extruded from the pug mills, they are cut off by an air-operated wire, operated automatically on signals from a metering mechanism. When you visit the Lapp plant, you'll see dozens of places along the production line where processes and controls are automatic. We do it this way because we found out how to make the best suspension insulator we could, and then wanted to make every one that good. The pay-off is in low initial cost to you, and long service on your lines.

Lapp Insulator Co., Inc., Le Roy, N. Y.

the clue to LONGEVITY!

Rip Van Winkle, the story book character, lived to a ripe old age —— and here our comparison ends, for though Rip slept through most of his lifetime, PORCELAIN PRODUCTS Insulators achieve longevity only by *wide awake* analytical research and rigid factory engineered test methods — OUR CLUE TO LONGEVITY, and your guarantee of a product that will outlast even old Rip.

EEI-NEMA CLASS 52-3 PP 66255



To guarantee maximum cement strengtn and conform with standards derived by analytical research, Porcelain Products' lab technicians subject all incoming cements and production mixes to exhaustive batch control tests such as the Gilmore Needle Test shown here. This particular test is used to determine the time of setting of cement, which insures consistency in production and gives the ultimate cement strength necessary for insulator assemblies - and is but one of such tests employed to guarantee product performance.

The 10" suspension insulators shown here were installed on the Boulder Canyon Project over 20 years ago - here is tangible proof of Product Reliability - and Longevity.

PP INC.

Porcelain Products, Inc.

High Voltage Division **Parkersburg, W. Va.**

***New* from INTERNATIONAL...**

New "go-anywhere" light-duty 4-wheel drive truck!

Here's the four-wheel-drive truck you've been waiting for! Here's a full-size, all-purpose truck you can use to go anywhere.

On or off the road, this new INTERNATIONAL S-120(4x4) will take the toughest grades in stride—fully loaded, it will move entire 7,000 lbs. of truck, body and cargo through soft sand, mud or snow. It's made to match all light-duty 4x4 jobs *exactly* with choice of 2 engines, 3 pickup and 2 stake bodies. Has exclusive INTERNATIONAL power take-off transfer case, plus optional power take-off transmissions for auxiliary equipment operation, is available in 6 tire sizes, including 7:00x18 for extra clearance and 9:00x16 for extra flotation and traction.

This newest INTERNATIONAL is all-truck built for rough, tough four-wheel-drive service . . . built to save you the BIG money, the operation and maintenance money. Before you buy any light-duty 4x4 truck, see and drive this one at your INTERNATIONAL Dealer or Branch!

INTERNATIONAL HARVESTER COMPANY • CHICAGO

A Complete Line of Light and Medium 4x4s for Every Tough Job Need

S-140(4x4). 11,000 lbs. GVW. Has 4-speed transmission and 2-speed transfer case, for 8 forward and 2 reverse speeds. 2 transmission power take-offs. Provision for third on transfer case.

S-160(4x4). 15,000 lbs. GVW. Has same transmission and transfer case as S-140 model, and like S-140 and S-120 has famous full-size Comfo-Vision cab and exclusive INTERNATIONAL features for easiest four-wheel-drive steering and handling.

INTERNATIONAL® TRUCKS

All-Truck Built to save you the BIG money!

Motor Trucks • Crawler Tractors • Industrial Power • McCormick® Farm Equipment and Farmall® Tractors

ADVERTISEMENT

ENGINEERING MEMO FROM KAISER K/W WIRE

1.1

FIRST OF A SERIES OF TECHNICAL ARTICLES TO BE ISSUED
ON SUBJECTS OF INTEREST TO THE ELECTRIC INDUSTRY

ALUMINUM SERVICE ENTRANCE CABLE

[ANOTHER NEW K/W PRODUCT]

By N.E.C. definition Service Entrance Conductor (Cable) is, "That portion of service conductors between the terminals of service equipment and a point outside the building, clear of building walls, where it is joined by tap or splice to the service drop or to street mains or other source of supply."

In other words, Service Entrance Conductor is the insulated wire attached to service drop cable at the weatherhead, extending in conduit or cable down the side of the house and through the wall into the service equipment switch inside the house. When used with aluminum service drops, Aluminum Service Entrance Conductors eliminate the need for bi-metallic connections. If it is Service Entrance Cable, it need not terminate at the weatherhead but could be supported at the house and be continuous to the secondary mains—acting as service drop as well as Service Entrance Cable.

In addition to its use in conveying electricity from the end of the service drop through the customer's meter to the customer's service equipment, large quantities of this product are used to connect large appliances such as ranges, water heaters, clothes dryers, and air conditioners.

For utilities wishing to assist in increasing service capacity in line with "adequate wiring" programs, aluminum service entrance cable makes the increased capacity economical, when compared to previous standard practices.

Service Entrance Conductors can be

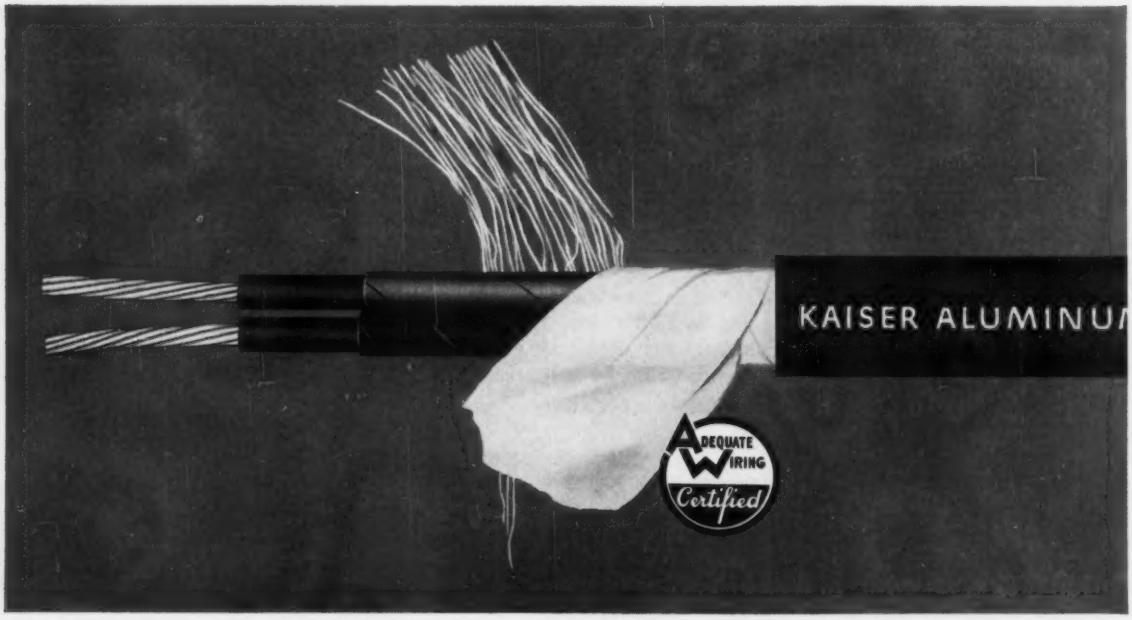
A) Single UL approved insulated conductors such as types TW, RH-RW, or other approved conductors *in conduit* from the weatherhead down and through the wall to the service switch, or

B) Cable without conduit and attached directly to the house, with or without a weatherhead depending on local code. Common overhead service entrance cable falls under the two main headings of

   1) Type SE which is not required to have protection against mechanical abuse, but must have a flame-retardant, moisture-resistant covering, and

   2) Type ASE which must have protection against mechanical abuse as well as have a flame-retardant, moisture-resistant covering.
   Under special conditions Type ASE can also be used as underground service entrance cable.

C) Cable underground. This cable is



ADVERTISEMENT

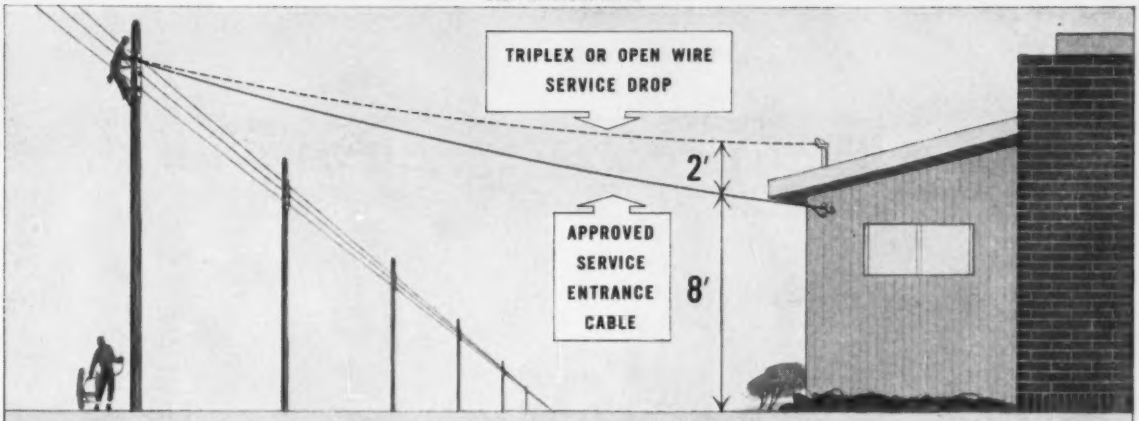


FIGURE 1

listed as Type USE—*not to be confused with* Type SE, Style U (often referred to as SEU). This cable is required to have a moisture-resistant covering but is not required to have a flame-retardant covering. Type USE is recognized for underground installation only.

Type SE Cable

Type SE (Style U) is available as either two- or three-conductor cable. The two-conductor cable is made up in round form with one conductor insulated with a thickness of RH-RW depending on size. Over this is a rubberized tape and fine wire concentric stranded neutral. The stranded neutral is covered with paper tape or "moisture dam," and the composite is then covered, respectively, with a neoprene jacket or saturated braid type outer covering.

The three-conductor cable is made up of two separately insulated conductors, one covered with a black tape and the other with red tape. The two conductors are laid flat and covered with a fine wire neutral, either the same composite size as the insulated conductor or two AWG sizes smaller. The neutral wires are ¾ hard and bind the insulated conductors together with no filler in the valley between conductors. The neutral is covered with either paper tape or other moisture barrier and either the neoprene jacket, or saturated braid type outer covering.

The cable is identified in two ways. Under the concentric bare neutral there are marker threads which identify the cable manufacturer. The other method of marking is surface printing of the cable, such as "Kaiser Aluminum 3-Condr-4-AWG-Aluminum-Type SE-Style U."

Current Carrying Capacity

Size AWG	Current Carrying Capacity* 60°C	75°C
10	25	25
8	34	38
6	46	55
4	59	71
2	80	97
1	93	110
1/0	105	125

These values are based on temperature alone and do not take voltage drop into consideration.

With regard to voltage drop, the National Electric Code specifies, "The size of the feeder conductor should be such that the voltage drop up to the final distribution point for the load . . . will not be more than 3% for power or heating loads and not more than 1% for lighting loads or combined lighting, heating, and power loads."

*Based on 30°C ambient and indicated conductor temperature for not more than three conductors in a cable. Calculated according to 1953 Edition of National Electrical Code.

Type SE (Style U) Service Entrance Cable does not require conduit protection where extending along or entering into buildings. It is sufficiently light in weight to be used as a service drop cable, thus eliminating terminators at the weatherhead if desired.

Also where attachments to buildings are low because of house design, this cable will meet the Underwriters' requirements for minimum clearance. (See Figure 1.)

* * *

During the electric industry's rapid expansion, Kaiser Aluminum has concentrated intensively on utility problems—with special emphasis on covered wire.

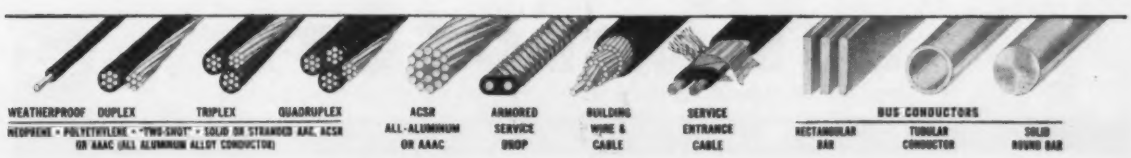
Today, Kaiser Aluminum is the nation's fastest growing producer of aluminum wire and cable, making available the latest helpful information on modern products and practices.

A Kaiser Aluminum representative or a K/W distributor will be glad to give you immediate attention. Call your Kaiser Aluminum sales office. Kaiser Aluminum & Chemical Sales, Inc., *Executive Office*, Kaiser Bldg., Oakland 12, California; *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois.

REPRINTS OF THIS ARTICLE AVAILABLE ON REQUEST

Kaiser Aluminum

THE NATION'S LARGEST PRODUCER OF
ALUMINUM WEATHERPROOF WIRE AND TRIPLEX



In 1928, The Pennsylvania Power & Light Company installed 163 pressure-creosoted poles on a distribution line in Lancaster County, Pa. Not one of these pressure-creosoted poles has been replaced due to decay or preservative failure. Amer Krieder, Pole Inspector, looks over one of these still-serviceable veterans.

In 1954, a total of 180 pressure-creosoted poles was installed for the new transmission line in an area between Hazelton and Wilkes-Barre, Pa. L. Z. Ludorf, Assistant to Superintendent of Lines and Substations, is shown here with one of the 55-foot poles in this line.

"Not one pole installed in 1928 has been replaced due to preservative failure,"

reports Pennsylvania Utility

The Pennsylvania Power & Light Company serves 674,000 customers in a 10,000 square mile area in Eastern Pennsylvania. On its many transmission and distribution lines it has approximately 250,000 pressure-creosoted yellow pine poles in service.

Mr. D. A. Campbell, Jr., Superintendent of Lines and Substations, has this to say about pressure-creosoting: "We have been specifying the pressure-creosote treatment for our poles since 1938, but we do have a record of a number of pressure-creosoted poles installed in 1928. Our test borings of these poles in 1949 indicated that we would not have to test again for at least another ten years. Our replacements due to decay are hardly worth mentioning. The fine performance of our pressure-creosoted poles in our old lines has certainly influenced us to use pressure-creosoted poles in our new lines. We feel that, on the basis of decay, the life expectancy of a pressure-creosoted pole is at least 40 years. We are also specifying pressure-creosoted crossarms to match the life of pressure-creosoted poles. This cuts our replacement and maintenance costs."

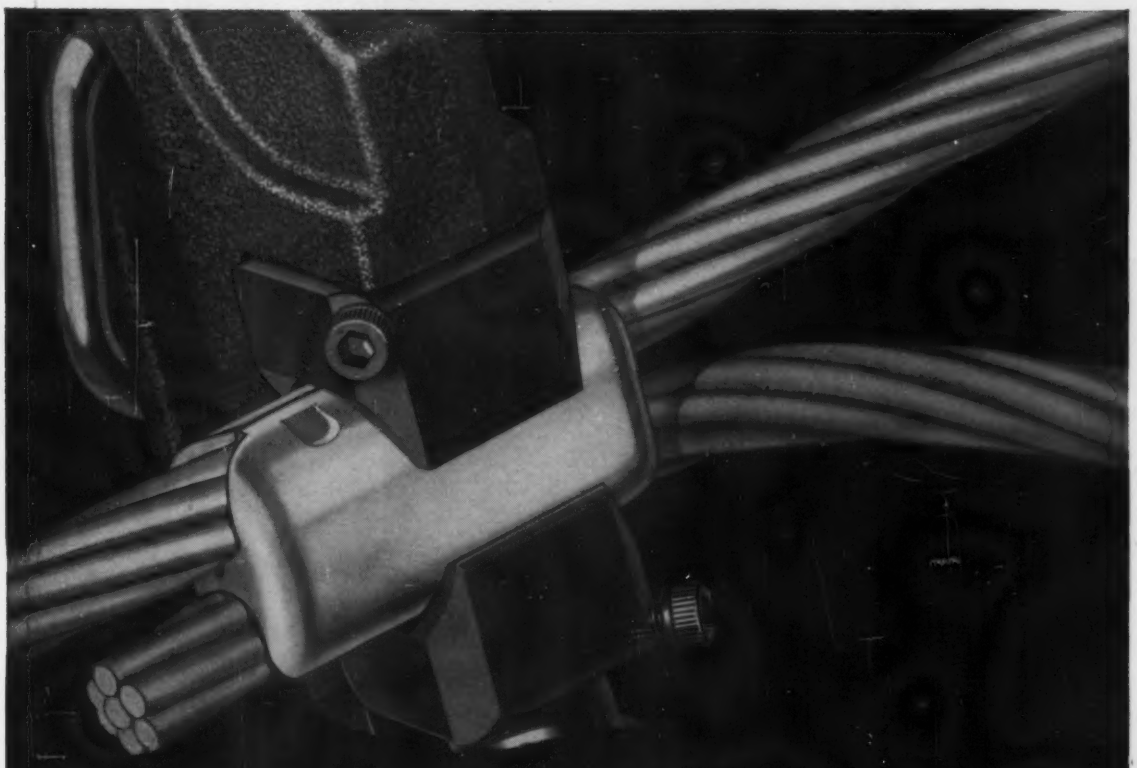
This is just one example of how power companies are benefiting from the long service life of pressure-creosoted poles and crossarms. For more data on pressure-treatment and USS Creosote—the quality preservative—write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.; or call the nearest United States Steel Chemical Sales Office.

USS CREOSOTE

SALES OFFICES IN PITTSBURGH, NEW YORK, CHICAGO, CLEVELAND, SALT LAKE CITY AND FAIRFIELD, ALA.

USS

UNITED STATES STEEL



for permanent connections...
at less cost

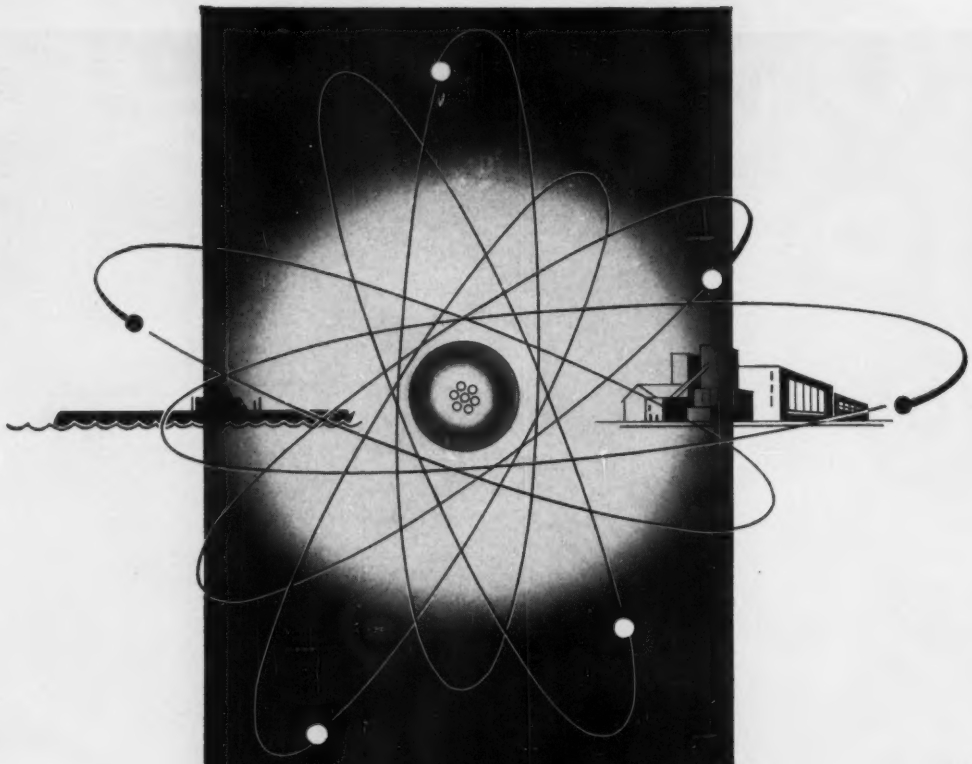
use KEARNEY SQUEEZONS

The exclusive "built-in spacer" eliminates the danger of corrosion or galvanic action. Conductors do not touch each other. Each is held around its entire circumference... separated by a metallic barrier. You can use versatile SQUEEZONS for copper to copper, copper to aluminum, aluminum to copper or aluminum to aluminum joints.

JAMES R. KEARNEY CORPORATION • 4224-42 Clayton Ave., St. Louis 10, Mo. • *Canadian Plant:* Guelph, Ont.

298

For BETTER CONSTRUCTION
SAFER MAINTENANCE
Specify KEARNEY
The Mark of Quality PRODUCTS

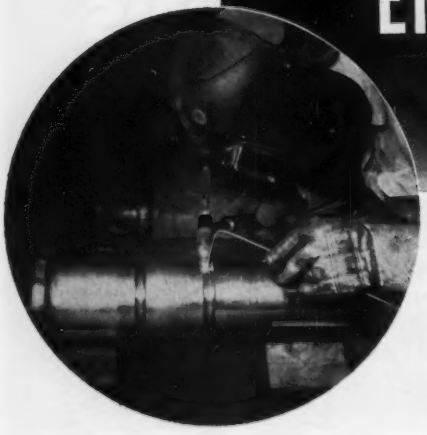


pioneers in piping for

ATOMIC ENERGY

since 1903
fabricators of
power and process piping
for these industries . . .

Electric Generating
Paper and Pulp
Chemical Processing
Basic Metals
Food
Textiles
Transportation
Manufacturing
Ordnance
Refining



P. P. & E. produced the first piping installations for marine and stationary nuclear power plants. Our facilities are complete —metallurgical research, laboratory service, engineering, shop fabrication, testing, and field erection. We have fabricated stainless steel piping for power and process industries since the middle 1920's.

OFFICES IN PRINCIPAL CITIES

Atlanta	*Whitehead Building*	*Hollywood*	*1828 North Alexandria Ave.*
Boston	*10 High Street*	*New Orleans*	*P. O. Box 74*
Chicago	*Peoples Gas Building*	*New York*	*Woolworth Building*
Cleveland	*Public Square Building*	*Syracuse*	*113 So. Salina Street*
Toronto	*68 Yonge Street*		

Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.

CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

PP-17

"Big jobs or Small... CROUSE-HINDS has Everything we need!"

says J. H. Blasdell, General Supt.,
Fisk Electric Company, Houston, Texas

"Take a big job like this new Public Grain Elevator in Houston where we handled all the electrical work. There were a lot of reasons why we chose Crouse-Hinds. First, we've used Crouse-Hinds Condulets for years and know their quality is tops. Then, too, on a big job like this we needed a large variety of plugs, receptacles, lighting fixtures, panelboards, switches and junctions . . . all in safe dust-tight construction for Class II hazardous locations. *We knew Crouse-Hinds could supply the complete bill!*

"Ordering from the Crouse-Hinds catalog is a cinch. Clear illustrations, concise specifications and an easy-to-follow numbering system all make my job much easier. Promised delivery dates were kept on everything, so I never had to worry about work stoppage. And Crouse-Hinds field engineers, located right here in their Houston office, were at our disposal 'round the clock to help us solve any special problems that might arise."

● There are more than 15,000 items listed in the Crouse-Hinds Condulet Catalog to meet nearly every need in hazardous or ordinary locations. Contact your nearby Crouse-Hinds distributor or field office for complete details.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

Main Office and Factory: Syracuse, N. Y.
Crouse-Hinds Company of Canada, Ltd.: Toronto, Ont.

OFFICES: Birmingham Boston Buffalo Chicago Cincinnati Cleveland Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Philadelphia Pittsburgh Portland, Ore. St. Louis St. Paul San Francisco Seattle Tulsa Washington. RESIDENT REPRESENTATIVES: Albany Atlanta Baltimore Baton Rouge Charlotte Chattanooga Corpus Christi Jacksonville Reading, Pa. Richmond, Va. Shreveport

the Miracle on

On the banks of the Ohio, right now, these two huge electric plants are turning out power at the rate of over 18-billion kilowatt-hours annually. They are, respectively, the first and second largest investor-owned power plants in the world.

They stand on what was farmland less than three and one-half years ago.

Their completion, substantially ahead of schedule, is the result of the outstanding teamwork of management, investors, engineers, technicians and workers in privately-owned utilities and their suppliers.

The vast power output of these plants, *almost half as much electricity as all France produces,* is ready to assure uninterrupted operation of the Atomic Energy Commission's uranium diffusion center near Portsmouth, Ohio.

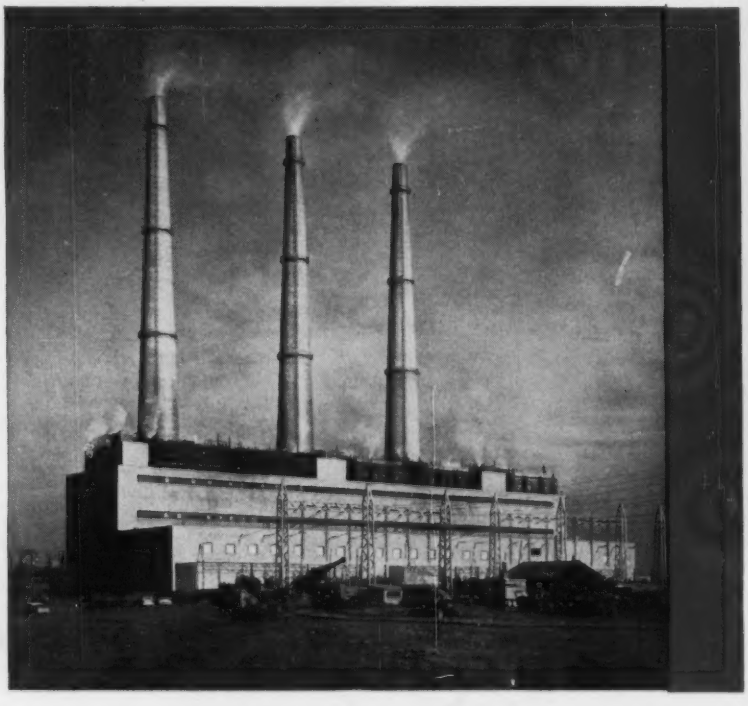
When the AEC made its enormous needs known, 15 private electric companies* joined forces to form the Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation. Pooling their resources in men, money and experience, they and their suppliers worked faster than the construction timetable. In quick order the 11 gigantic B&W boilers, the turbines, generators, buildings—and all the vast complex of auxiliary equipment—were designed, built and placed into operation.

The first generating units were placed in commercial operation in February 1955. The final unit went on the line in February 1956 at Clifty Creek, marking the largest installation of power in a single project ever made in a twelve-month period.

All Americans can be proud of OVEC-IKEC for this great accomplishment. What appears to be a miracle, in reality is, a clear demonstration of what private enterprise and enlightened government, working together, can accomplish for the benefit of the entire nation.

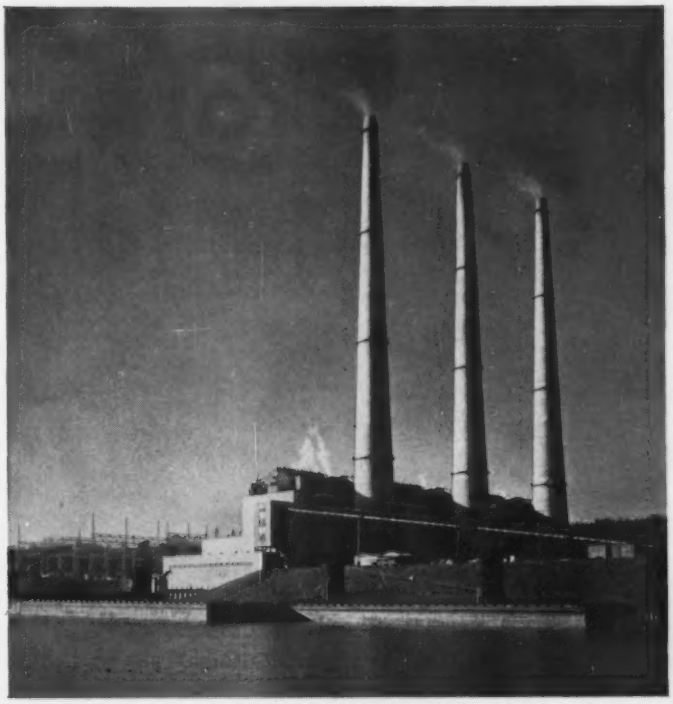
The future will undoubtedly pose many similar challenges. Can they be met? Are enough young engineers, business men, technicians, and skilled workers being developed to accept these great responsibilities? Babcock & Wilcox, like so many other American firms, is pledging its resources to guarantee that the answer will be "Yes!" Recruiting and training young men, expanding and modernizing production facilities, conducting extensive research and engineering development projects—all are part of a long range B&W program to contribute its share to the technical and economic progress so necessary for the continued growth of the nation.

The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

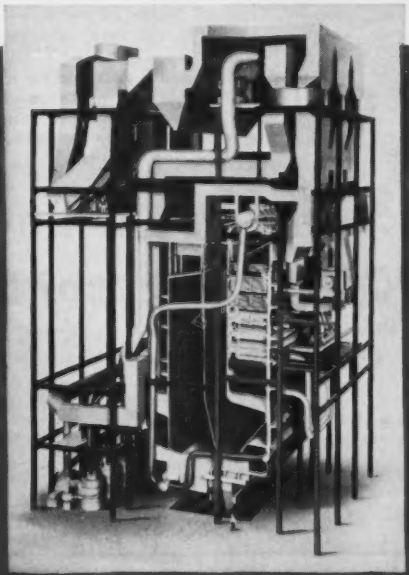


KYGER CREEK PLANT, at Cheshire, Ohio, with a capacity of 1,075,000 kilowatts, is the world's second largest investor-owned power plant.

the Ohio River



CLIFTY CREEK PLANT, at Madison, Indiana, with a capacity of 1,290,000 kilowatts, is the world's largest investor-owned power plant.



11 B&W Open-Pass Boilers generate steam for the two plants. Each boiler produces 1,330,000 lb of steam per hr at 2000 psi and 1050 F, with reheat to 1050 F. The utilization of high temperatures, high pressures and reheat at both plants places them among the most efficient and economical in operation.

***SPONSORING COMPANIES OF OVEC-IKEC**

Appalachian Electric Power Company* • The Cincinnati Gas & Electric Company • Columbus and Southern Ohio Electric Company • The Dayton Power and Light Company • Indiana & Michigan Electric Company* • Kentucky Utilities Company • Louisville Gas and Electric Company • Monongahela Power Company** • Ohio Edison Company • Ohio Power Company* Pennsylvania Power Company*** • The Potomac Edison Company** • Southern Indiana Gas and Electric Company • The Toledo Edison Company • West Penn Power Company**

* Subsidiary of American Gas and Electric Co.
** Subsidiary of The West Penn Electric Co.
*** Subsidiary of Ohio Edison Co.

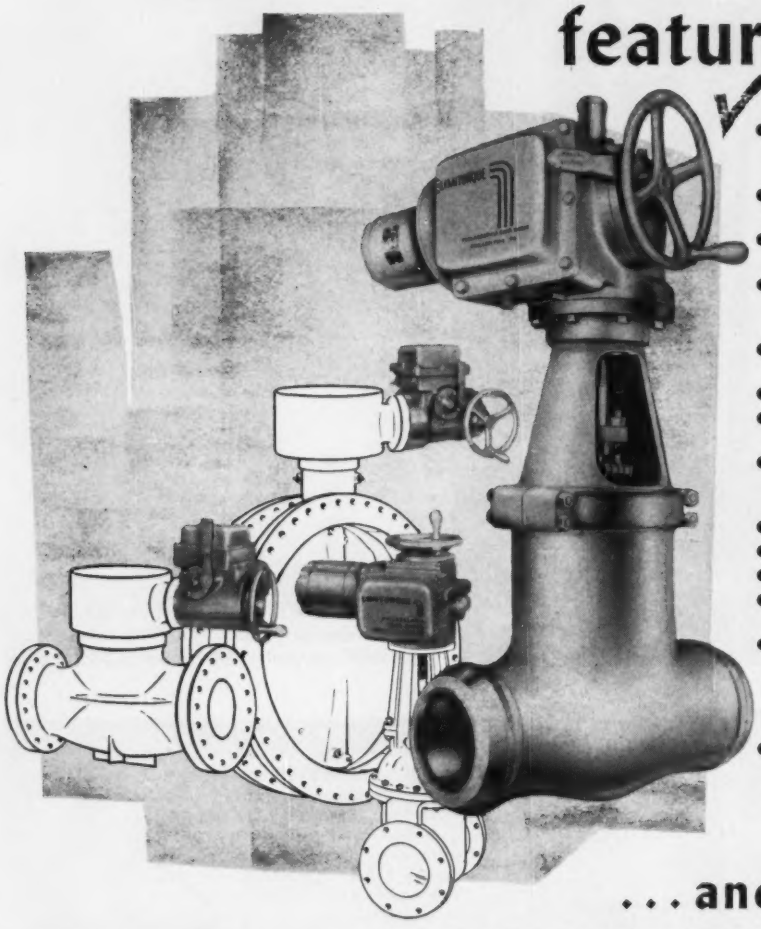
G 749

BABCOCK & WILCOX

B&W

BOILER DIVISION

Check these features



- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

. . . and you'll understand why more *LIMITORQUE* valve controls are in use than all others combined

Send for new catalog L-550, and please use your Business Letterhead when requesting.

LimiTorque®

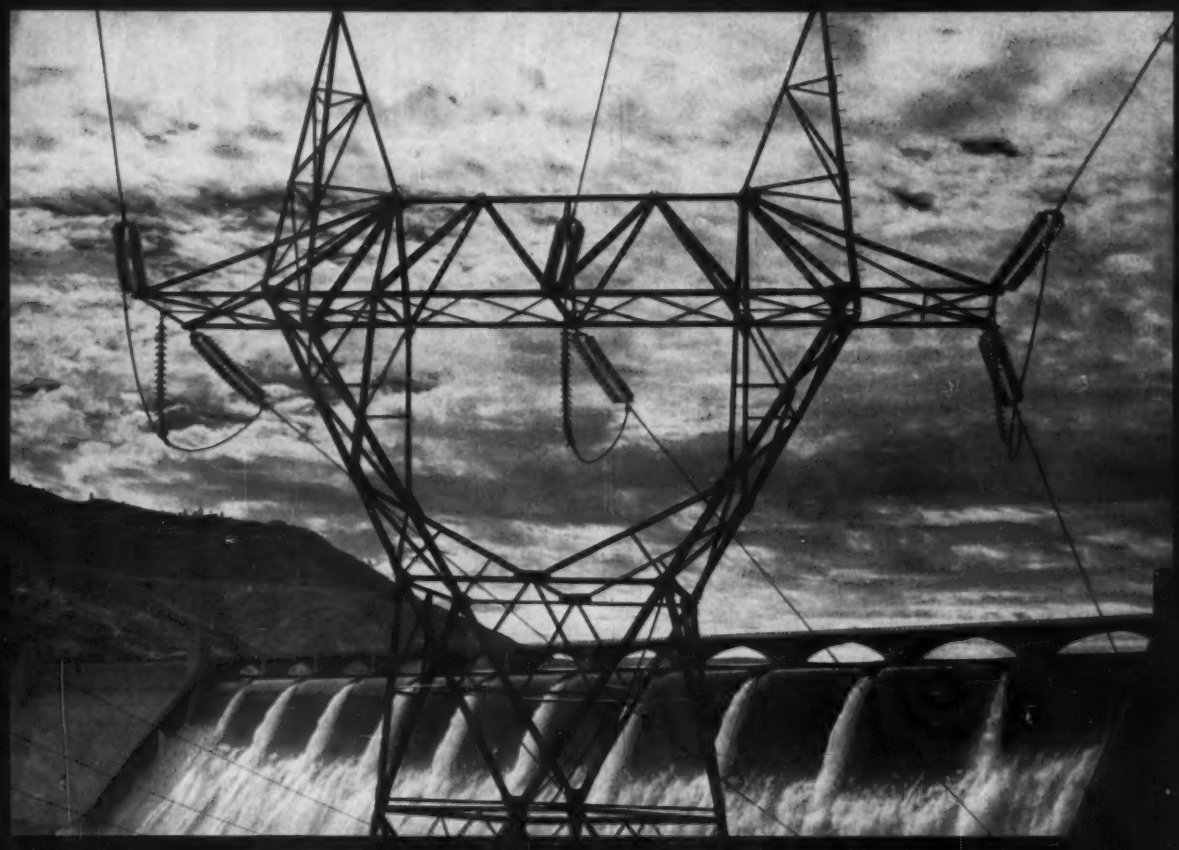
PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia



Cable insulation that can't take it . . . is water over the dam!

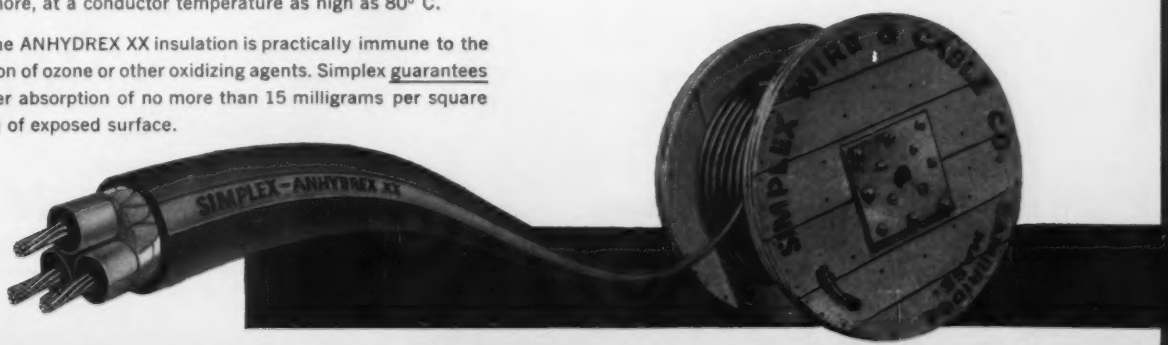
Losing power through weak cable insulation is fast becoming a thing of the past. For, more and more, today's trend is toward Simplex-ANHYDREX XX insulated cables — which withstand the toughest punishment in any location.

Simplex-ANHYDREX XX insulated cables are designed and built to operate under conditions that would destroy any other insulation. They operate at voltages of 2,000 to 25,000 or more, at a conductor temperature as high as 80° C.

The ANHYDREX XX insulation is practically immune to the action of ozone or other oxidizing agents. Simplex guarantees water absorption of no more than 15 milligrams per square inch of exposed surface.

Features like these are making Simplex-ANHYDREX XX cable first choice for all power transmission lines—no matter where the location or what the conditions.

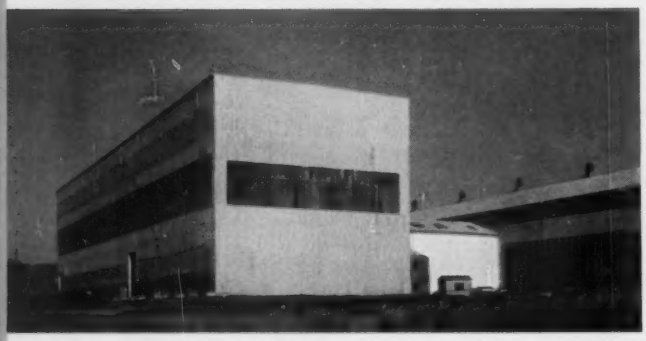
Be sure to specify Simplex-ANHYDREX XX for your high voltage applications. For more information, write for booklet 1009. **SIMPLEX WIRE & CABLE CO.,** 79 Sidney Street, Cambridge 39, Mass.



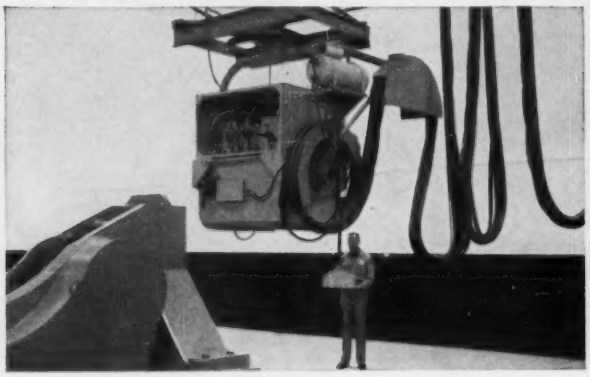
NUCLEAR

ARCHITECT'S DRAWING of Engineering and Administration Building — part of the Nuclear Engineering and Development Center Combustion is building on a 530-acre site at Windsor, Connecticut. When completed, this Center will contain all the specialized facilities required for the development, design and test of nuclear power reactors, for the construction of reactor cores and for the manufacture of fuel elements.

THIS NEW DOCK at our Chattanooga Division will permit water shipment of reactor vessels too large and heavy for rail or highway transport. Its two cranes have a lifting capacity in excess of 300 tons.

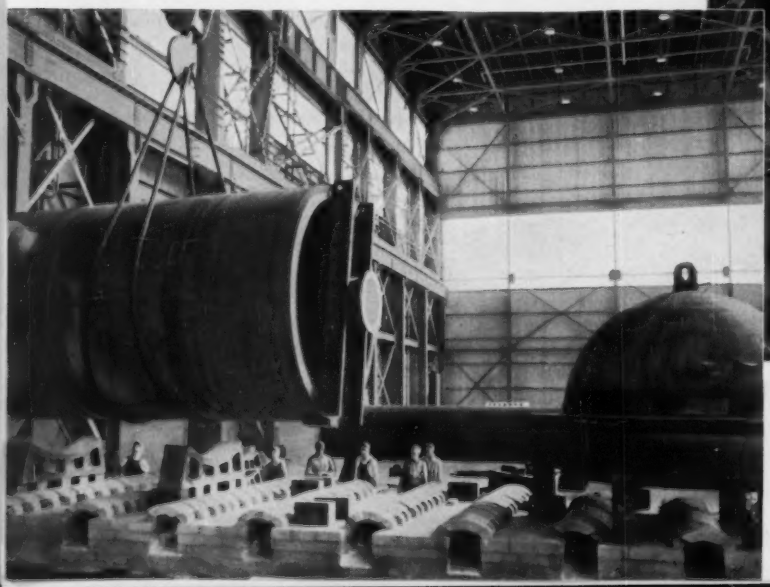


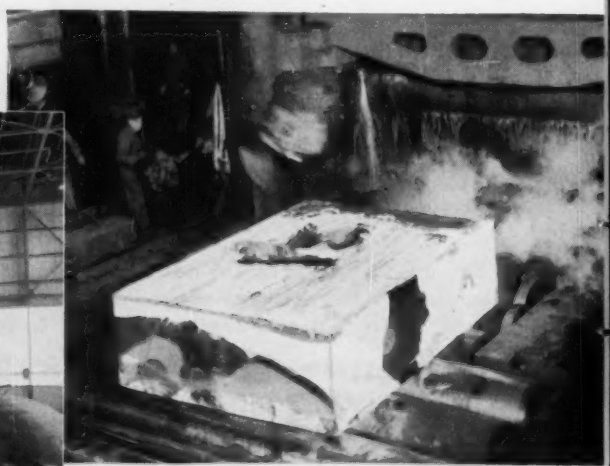
THIS NEW NUCLEAR BUILDING, located at the Company's main plant in Chattanooga, Tennessee, has been designed for the manufacture of heavy nuclear components. It is the first facility in the country to be built for this purpose.



THIS 15,000,000 VOLT BETATRON is used to radiograph the extremely thick steel walls of reactor vessels. Using exceptionally high energy levels, it can X-ray metals in a fraction of the time required by the conventional industrial X-ray machine.

SHOWN BELOW are a reactor vessel shell and head being placed in position on the loading car of a heat treating furnace. Some idea of the size of these components may be gained by comparison with the men in the center of the picture.





ROLLING STAINLESS-CLAD STEEL PLATE at the steel mill. This slab was reduced to a thickness of about 8½ inches and was used to fabricate the vessel shown at the left.

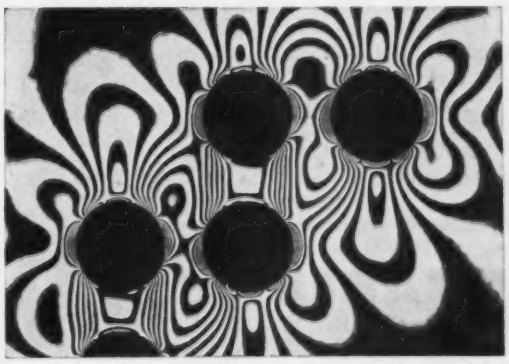
ACTIVITY AT C-E

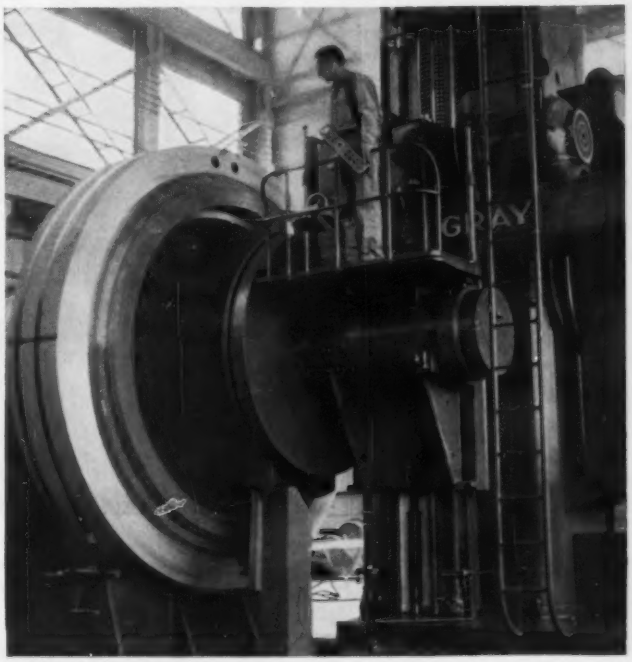
Since it began in 1946, nuclear activity at C-E has expanded to encompass almost all phases of power reactor engineering.

Today, Combustion is engaged in the development, design and manufacture of both light and heavy reactor components as well as a complete reactor system for a submarine. The scope of its activities encompasses Pressurized Water, Fast Breeder and Liquid Metal Reactor work. This work includes projects for Naval ship propulsion and electric power stations. Shown at left and below is a pictorial sampling of certain of these activities. It is a two-part story. The first deals with nuclear facilities—built and building. The second pertains to work performed.

Thus, for the last decade, Combustion has been preparing itself—through the acquisition of facilities and the accumulation of knowledge and experience—for the challenging task of applying nuclear fission to the power needs of the future.

THESE PHOTOS, (above and below) showing the strange patterns of stress concentrations, were taken of a plastic model of a reactor vessel loaded to simulate the strains under which a real reactor vessel would operate.





THIS HORIZONTAL BORING MILL is being used to machine the 10-inch-thick head of a large reactor vessel. The diameter of the head is approximately 9 feet. This mill is one of a number of large precision machine tools capable of handling work with accuracies comparable to those required in watchmaking.

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

steam generating units; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; home heating and cooling units; domestic water heaters; soil pipe B-933

Prometheus, one of the earliest characters in classical mythology, gave the gift of fire to mortals and was punished for this infringement on the gods. He was bound to a rock to be devoured by an eagle and by the elements. But Prometheus persevered over all. His name still symbolizes enormous endurance over incredible hardship.

ENDURANCE BREEDS CONFIDENCE

Symbols that clearly show unusual endurance over the elements are uncommon. The mythological Prometheus represents strong day-after-day endurance. There's another such symbol, too . . . but not fictional. Kerite Cable, year in, year out, successfully resists the damaging effects of time and the elements. Whether exposed to the humid heat of the tropics, or the rigors of the cold damp Arctic, Kerite, wherever it is used, can be relied on for outstanding performance. That's why there is little cause for surprise when Kerite Cable laid in unusually difficult installations 40 or more years ago is found still to be in perfect operating condition today. Kerite's acceptance is greatest with those who have used it longest. Endurance, over the years, breeds confidence.

The value and service life of a product can be no greater than the integrity and craftsmanship of its maker.

Founded 1854

KERITE CABLE

THE KERITE COMPANY—30 Church St., New York 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago; 582 Market St., San Francisco;
3901 San Fernando Rd., Glendale 4, Calif.; 31 St. James Ave., Boston

EDITORIALS

Atomic Power Will Be Competitive

The future of atomic power now seems assured. Control of the fission reaction to generate electricity is an accomplished fact, first achieved in December 1951 at Arco, Idaho. Safe and reliable control of reactors has been demonstrated by the Atomic Energy Commission and its contractors. And the mature engineering judgment now focused on its application to full-scale generating plants will solve the remaining problems.

Economy remains the biggest unsolved barrier to widespread adoption of atomic power. But successful completion of development programs now in progress is expected to show the way to economical power production. Confirmation of this is found in an article by Kenneth Davis, director of AEC's Reactor Development Division, beginning on page 129.

Actually the one big question today is—When will atomic power be competitive? The answer will depend somewhat, of course, on what the future holds for fossil fuel competition. But it depends to a larger degree on bold planning and aggressive action by the utility industry.

Already this industry has mobilized its engineers for the series of atomic plants it has proposed building. These utility engineers can be expected to contribute valuable improvements to atomic plant design and operation. They may, for example, find ways to overcome the stringent provisions for containment which are considered essential today. Or they may find auxiliary equipment reliable enough with one pump or one valve where conservative design today provides duplicates. Their long record of improvements in conventional power plants is a measure of the effectiveness of their mature judgement.

In the non-technical area insurance remains the prime problem. Solution would be easier if it could be based on operating experience. But the financial risk in atomic power demands insurance coverage before operation begins. News of recent weeks suggests that this problem will soon be solved. Growing collaboration among government agencies, insurance groups, and utilities gives promise of an early solution. Insurance needs will not bar for long the development of atomic power.

Prepare for Peaks Ahead

Peak loads for 1956 will cut deeply into generating margins carried over from 1955's record expansion. Growth last year exceeded forecasts. And generator shipments during recent months have been at the lowest annual rate since 1948.

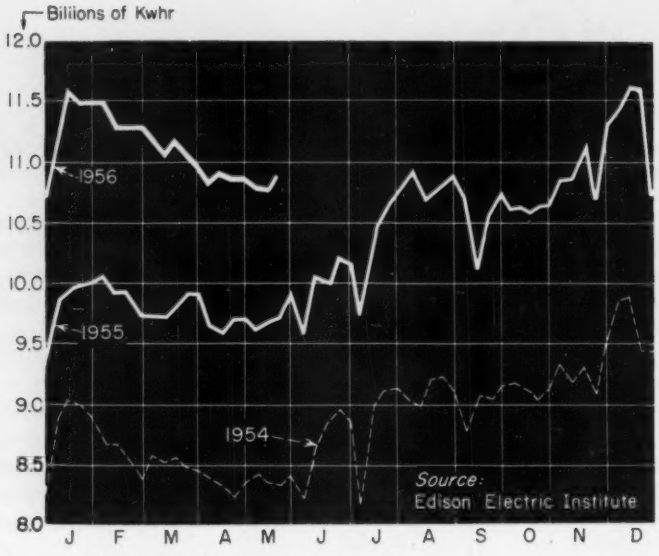
This low production stems in part from the Westinghouse strike. But the situation is aggravated by the sharp curtailment in orders placed two years earlier. At that time, one manufacturer pointed out that orders placed during the previous six-month period were for but 10% of the capacity shipped (EW July 12, 1954, p 140). Another warned that continued refusal to order turbine generators threatened to disrupt facilities for building them (EW, Oct. 11, 1954, p 59). Both manufacturers offered concessions in cancellation charges to induce resumption of the turbine business.

Load growth, meanwhile, consistently exceeded expectations. And growth predicted for 1956 in EEI's 19th Semiannual Electric Power Survey exceeds scheduled capacity increases by 0.4 million kw. The obvious result is an encroachment on operating margin. For the industry as a whole, this margin will remain at a workable level, provided off-peak time can be found to overhaul large generating units. But for the Pacific Northwest and some individual systems in other sections operating margins will practically vanish.

Not until 1957 does the production schedule for turbine generators approach manufacturing limits. Shipments of thermal and hydro units for that year are expected to approach the 1955 record of 12.5 million kw. When these units go in service in late 1957 and early 1958, they will compensate for expected load growth. Operating margins by 1958 should return to a more comfortable level.

ELECTRICAL WEEK

LAST MINUTE



OUTPUT

Week ended May 19
10,875,000,000 Kwhr
Up 11.8%

Atomic Energy Commission requirements — 1,125,000,000 kwhr (Electrical World estimate). Excluding AEC, output increase was 9.0%

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
May 19	+11.8	+11.3	+7.7	+16.9	+9.3	+11.0	+14.1	+12.3	+12.3	+5.3
May 12	+12.0	+11.3	+7.3	+16.9	+10.4	+9.8	+11.8	+14.6	+15.5	+10.6
May 5	+12.8	+12.9	+7.5	+18.9	+11.1	+12.3	+6.4	+13.6	+15.1	+11.4

Seasonally Adjusted Index 214.9 Week Ago 214.8 Year Ago 192.3

Issue's Highlights . . . Supplemental government insurance coverage for atomic power installations looms as probable result of Joint Congressional Committee hearings . . . Compromise plan is pushed for Niagara with joint state-private development . . . Georgia Power signs agreement to wheel Clark Hill power to preference customers . . . Babcock & Wilcox starts producing atomic fuel elements . . . EEI's Power Survey shows reserve margins (p 116); reveals status of orders, production, and shipments of large generating equipment (p 224).

"Indefinite recess" of bargaining sessions continues as Federal Mediator John Murray talks with negotiators for Westinghouse Electric and UE. No progress is reported in efforts to settle labor troubles that have shut down Westinghouse's South Philadelphia turbine plant for more than seven months.

Drop in copper price below 40¢ level by end of this year and ample copper supplies to meet consumer needs are predicted by Purchasers' National Committee on Non-ferrous Metals.

Two-year contract signed by Niagara Mohawk Power and IBEW provides for 5% wage hike effective June 1. Agreement between the utility and 12 local unions calls for reopening of basic wage-rate provisions on June 1, 1957.

Morgan Stanley & Co group wins $30-million Consolidated Edison Co of N. Y. (Aa) first mortgage 3⅜% bonds due 1986 at 100.7599%; reoffers at 101.3777% to yield 3.55% . . . Halsey Stuart & Co group wins $7.5-million Iowa P&L (Aa) first mortgage 3⅜% bonds due 1986 at 100.929%; reoffers at 101.749% to yield 3.53%. Iowa P&L is also offering 226,871 common shares to shareholders on 1-for-8 basis, record May 23 to expire June 7, at $24 a share to yield 5.83%. First Boston group wins bid to underwrite the common issue with a compensation of 14.982¢ a share.

NEWS OF THE INDUSTRY BRIEFLY TOLD

Off the Washington wire . . . K. L. Scott, director of Agricultural Credit Services, will take over temporary direction of REA pending appointment of a successor to Ancher Nelsen. Fred H. Strong continues as deputy administrator. As to Nelsen's successor, apparently David A. Hamil of Colorado is still leading contender . . . House Public Works Committee, in voting funds for TVA, Interior Department's four power agencies, and Corps of Engineers, is endorsing power revenue financing for TVA expansion. The Committee finds TVA's power revenues "have provided it with sufficient funds" for construction of additional units. Also, Committee's report accuses Administration of seeking means of "curtailing further expansion and development of REA cooperatives."

Need for immediate construction of a new power grid system is cited by Gov J. B. Johnson as vital step in meeting Vermont's future power needs. Albert A. Cree, president of Central Vermont PS, estimates that a new grid system for handling St. Lawrence power will cost from $10 to $15 million.

Rate reduction of $900,000 is result of four-year electric rate ordinance signed by Cincinnati G&E and Utility Committee of Cincinnati City Council . . . Tacoma, Wash., City Council approves $74,000 a year hike in wholesale rates, affecting mutual and cooperative power companies in areas adjacent to the city . . . Wisconsin Public Service cuts urban residential rates by estimated $200,000 annually after $120,000 a year reduction in August 1952.

In spite of recent defeat at polls of proposed revenue bond issue to construct 30,000-kw Beaver Marsh hydro project, Eugene (Ore.) Water & Electric Board is considering plan to build structures and power house under its FPC license and take sales contract for the energy.

"We are not building an atomic bomb," Chairman H. R. Searing tells annual meeting of Consolidated Edison stockholders in calming anxiety about safety of proposed Indian Point nuclear power plant. Searing says that most comments on hazards are "based upon a lack of understanding of what happens in an atomic plant. Our reactor will produce heat under closely controlled conditions—heat to produce steam to generate electricity."

ABOUT PEOPLE IN THE INDUSTRY

"A most reprehensible way to operate," is the charge of Rep Charles R. Jonas (R-N.C.) against last week's disclosure of a staff report of Democrat-dominated Chudoff subcommittee that investigated administration power policy. Rep Earl Chudoff (D-Pa.) denies any knowledge of release of the report which recommends that the President dismiss two Interior Dept aides. "I intend to do all I can to track this down," Jonas declares.

Ohio Gov F. J. Lausche (l) and Indiana Gov G. N. Craig dedicate Kyger Creek (OVEC) and Clifty Creek (IKEC) Plants producing total of 2,365,000 kw for AEC. Plaque at each plant reads: ". . . to the service and defense of this nation by investor-owned electric utility companies."

More News About People page 232

WALKER CISLER | WILLIS GALE | H. R. SEARING | WILLIAM WEBSTER

Atom Insurance Problem Gets Airing

- Supplemental government coverage looms as result of Joint Congressional Committee hearings on insurance for private atomic power plants
- Industry spokesmen indicate insurance problem could be stumbling block in way of fast, thorough development of private atom

The Congressional Joint Committee on Atomic Energy has wound up a set of friendly hearings on insurance for private atomic power plants. One probable result: The government will step in where private insurers still fear to tread heavily.

As the hearings ended, it was a good bet that the next few weeks—before Congress quits for the summer—will see perfection of and action on a government-backed indemnification program based on these broad general principles:

Government Insurance Shaping

- A requirement that private reactor operators buy the maximum amount of private insurance available. (The insurance industry says now it can offer up to $65-million coverage as a maximum for any one accident.)
- Statutory government assumption of liability for any damages above that private limit and up to a specified maximum per accident. (Sen Clinton P. Anderson (D-N.M.) and most joint committee members apparently favor a $500-million-per-accident ceiling. Thus, in a $200-million industrial atomic catastrophe—assuming $65 million of private insurance in force—the government liability would amount to $135 million.)
- In catastrophic incidents doing more than $500-million damage, or whatever maximum of government liability is enacted, two steps would be taken: (1) Available insurance and government indemnity would be prorated among damaged claimants and (2) Congress would be asked to pass special legislation to cover losses in excess of the statutory maximum.
- For indemnifying the operators, the government would charge no premiums, only nominal annual fees. The money would be applied to reactor research and development programs of the Atomic Energy Commission.
- The government would bow out of the picture as quickly as private insurers commit themselves to handling the risks. All agree that this will occur, once the private industry passes through its experimental pains and commences operating commercially on a scale big enough to compile some reliable statistics on actuarial probability.

Congressional Okay Expected

Senator Anderson thinks there will be little difficulty in getting Congressional approval of an indemnification program before this session ends. The joint committee staff is at work now on proposed legislation, but when it will be ready to take to the House and Senate floors is anybody's guess at this stage.

In the interim, the joint committee plunged into hearings on the bill introduced by Sen Albert Gore (D-Tenn.) who proposes to create a nationwide federally built and operated network of atomic reactors to produce commercial electric power (see page 22).

Private power industry spokesmen were united in subscribing to federal indemnification for their infant industry through its borning period.

No Other Roadblock Seen

Willis Gale, chairman of Commonwealth Edison Co, told Anderson, "Assuming that a solution to the insurance problem will be forthcoming, I see no other roadblock to impede the progress of our project." Commonwealth Edison is now building a 180,000-kw all-nuclear plant about 50 miles southwest of Chicago.

H. R. Searing of Consolidated Edison Co of New York took a similar view in regard to his firm's reactor at Indian Point in Westchester County, N.Y. Searing said Con Ed is going full speed ahead on the project, assuming that adequate insurance will be available by the time it is needed. But Searing also said he thinks Con Ed would ultimately leave the plant idle unless and until all risks are insured.

Actually, the hearings were on more roadblocks than insurance. Anderson counseled the industry to speak up

now on the need for Congressional action and governmental concessions or else hold its peace.

Walker Cisler of Detroit Edison Co, as president of Power Reactor Development Co, did speak up on other matters. He urged consideration of two more aids: (1) Tax revision to permit expenditures for atomic development to be treated as expenses rather than capital additions, and (2) exemptions from the Public Utility Holding Company Act for firms engaging in a joint subsidiary venture to generate electric power by atomics.

Congress' View of Cisler Appeal

But Congress is not likely to do anything about tax revisions along the lines suggested. And on the second point, if Congress does anything it will be less than Cisler would like. Probability now points to limited exemptions from the Holding Company Act, to apply only if the subsidiary generating company is nonprofit and only during the period of experimentation. In other words, the exemption of parent companies would be withdrawn once the subsidiary produced commercial power.

William Webster, president of Yankee Atomic Electric Co, told Anderson—in response to direct questions—that the Securities and Exchange Commission has already given members of his group the necessary exemptions from the act. Further, Webster said, Yankee anticipates no problem that would cause it to ask for a tax revision like that proposed by Cisler.

Hearings Focus on Insurance

Charles H. Weaver, vice president of Westinghouse Electric Corp, took a wide-vision glance at the industry and noted several problems adversely affecting full-scale development of the industry. But most of them are scientific or technical, and "the insurance problem appears to be the only one which can quickly be resolved by the Congress."

Thus it was that the hearings, a week of them, boiled down quickly to center on insurance. There are many diverse and complex aspects of the insurance problem which have yet received little more than fleeting attention in Congress—or elsewhere.

The rate question, of course, is uppermost in industry minds. The hearings produced little of substance on that point. H. W. Yount, vice presi-

(*Continued on page* 119)

Compromise on Niagara Seen

. . . with joint state-private development; Senate approval of Lehman bill draws fire from New York utility executives

There is feeling in Washington that a compromise might be worked out on legislation for development of the Niagara River.

Although the Senate adopted legislation sponsored by Sen Herbert Lehman (D-N.Y.) giving the job to New York State Power Authority, with full preference rights, the chances are the bill will not be acceptable in the House. Two years ago the House voted overwhelmingly for private company development. Sentiment there still is against the Lehman bill.

While chances seem to be growing dimmer for legislation for private company development of Niagara, the best indication of the future course of the long-standing controversy comes from Rep William E. Miller (R-N.Y.). Miller predicts that a compromise will be worked out calling for joint private company-state power authority handling of the project.

Former New York Gov Thomas E. Dewey threw his weight against the Lehman bill on the basis of the preference clause. In a telegram to Sen Irving M. Ives (R-N.Y.), Dewey said ". . . . I am unalterably opposed to the preference provision of this bill. I could not therefore support it in its present form and I hope it will be defeated."

Top executives of the five New York private utilities which have been seeking right to develop Niagara waters had this to say about the Lehman bill:

Alexander M. Beebee, chairman of the board, Rochester Gas & Electric Corp—"Such a bill can only lead to another 'TVA' (Tennessee Valley Authority) in New York State, at a time when efforts are being made to correct the inequities which TVA has created. . . . The expansion of such special privilege should not be extended further but should be stopped while it represents only 12% of the country. The Lehman bill gives special privilege to less than 5% of the people in New York State and discriminates against the remaining 95%. . . ."

Earle J. Machold, president, Niagara Mohawk Power Corp—"(The Senate vote on the Lehman bill) . . . reflects the tremendous pressures which have been exerted by public power advocates throughout the country to avail themselves of this opportunity to gain a foothold in the northeast section of the U. S. Their efforts obscured in the Senate the law and policy of the state of New York, the overwhelming desires of its people, and the utter inapplicability of public power philosophies to the fully developed Niagara project area."

Joseph M. Bell, Jr, president of New York State Electric & Gas Corp—". . . It is almost inconceivable that 47 senators from other states would impose on the people of the state of New York, against their will, an unfair bill like the Lehman bill which would discriminate so unjustly against 95% of those people. The preference clause contained in the Lehman bill is . . . designed to socialize the electric industry."

Ernest R. Acker, president Central Hudson Gas & Electric Corp—"Should this bill become law, the utility systems of this country would be on notice that government, federal or state, can go into the business of generating, transmitting, and distributing electric power anywhere in this nation at any time. . . . The provisions of the Lehman bill . . . (embrace) unfair practice of preference and discrimination and unfair competition to existing utility systems. . . ."

Harland C. Forbes, president, Consolidated Edison Co of New York—"The bill adopted by the Senate . . . goes farther than Congress' right to specify how and by whom the water of Niagara shall be used. It preempts the state's legal prerogative to regulate its public utilities. This is a serious invasion of states' rights. Con Edison, and the other electric companies associated in the Niagara project, are in the business of supplying power . . . at the lowest practical cost consistent with high standards of service. We consider it our duty to develop the best available sources of power for the benefit of our customers."

Estimated 4-Year Energy Reserves for U.S. Vary from 16% to 19%

Edison Electric Institute has released its 19th Semiannual Electric Power Survey. Basic findings of the study are:

- Capability of the U. S. electric power systems will increase 33% over the four years ending 1959.
- Peak load will parallel capability with a 33% growth.
- Gross reserve margin for December of each of the four years will vary between about 16% and 19%.

These findings were reported by the Electric Power Survey Committee of EEI in cooperation with the power area representatives of the electric power systems.

The survey covered about 97% of the capability and 98% of the energy output of the country's electric systems including investor-owned companies and federal and non-federal agencies. All data relating to capabilities, loads, margins, and energy outputs are based on the specific coverage of the survey and are not adjusted for 100% coverage.

The committee found that capability of the U. S. systems reached over 116-million kw at the end of 1955 and is scheduled to top 154-million kw at the end of 1959. This estimate and those in the accompanying charts are for median hydro conditions.

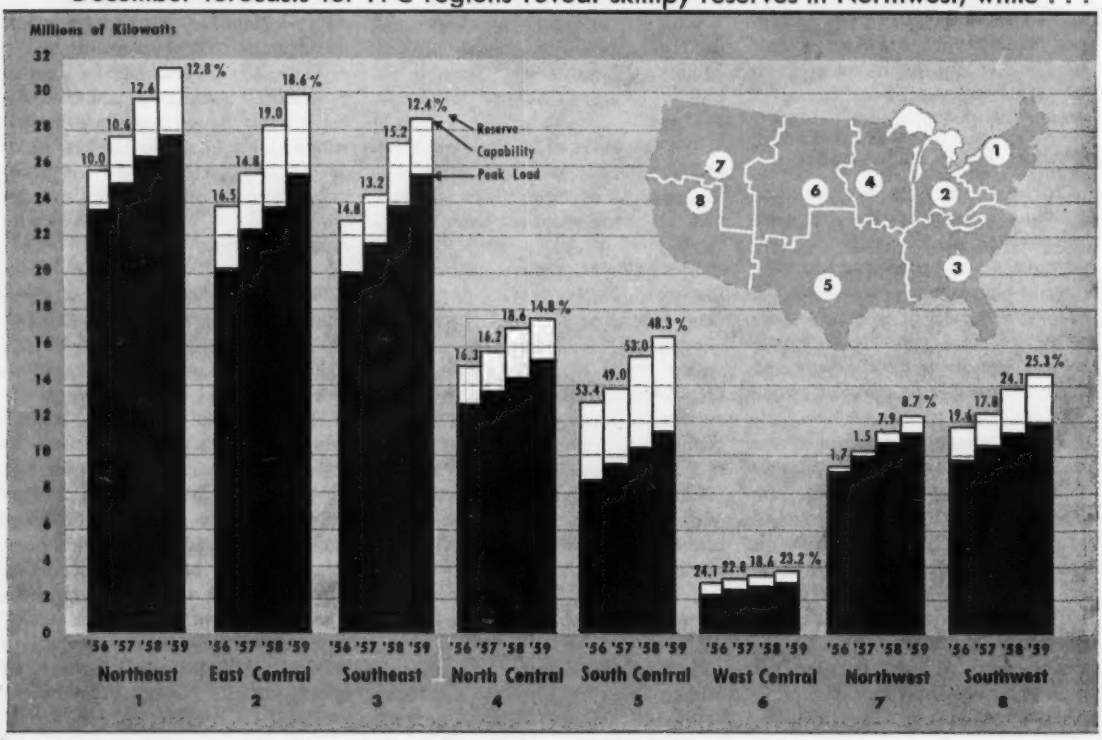
Peak load for December 1959 is estimated at 130.6-million kw, a 33% increase over the actual December 1955 peak load of more than 98-million kw. The committee placed the 1959 summer peak load at 97% of the peak for the following December. This summer-to-December ratio was 93% in 1955.

The gross margins predicted for the eight Federal Power Commission regions reflect favorable situations except in the Northwest, Region 7, where present forecasts show margins substantially below previous estimates.

The Power Survey Committee observed that in Region 7 "upward revisions of 1956 and 1957 peak loads estimates, coupled with lowered estimates of peak capabilities for those years, result in gross margins substantially lower than previously forecast."

Under favorable conditions Region 7 could carry the loads satisfactorily, the committee stated. However, adverse water conditions in the mainly

December forecasts for FPC regions reveal skimpy reserves in Northwest, while . . .



hydraulic West Division of the region "would likely create a deficiency of energy, notwithstanding the fact that installed generating capacity would be ample to carry the peak loads."

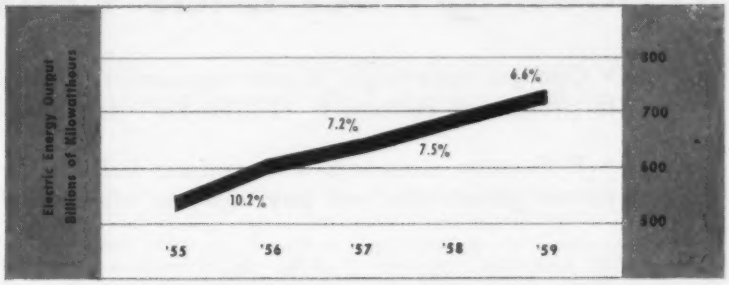
If adverse hydro conditions occur in the Northwest, water can be conserved by dropping contractually interruptible loads during part of the time, the report said. However, the committee estimated that "all firm loads can be satisfactorily carried even under adverse hydro conditions."

The committee noted that "as stated in previous survey reports, summer loads on many of the country's power systems have during recent years been approaching and in some cases exceeding the December peaks."

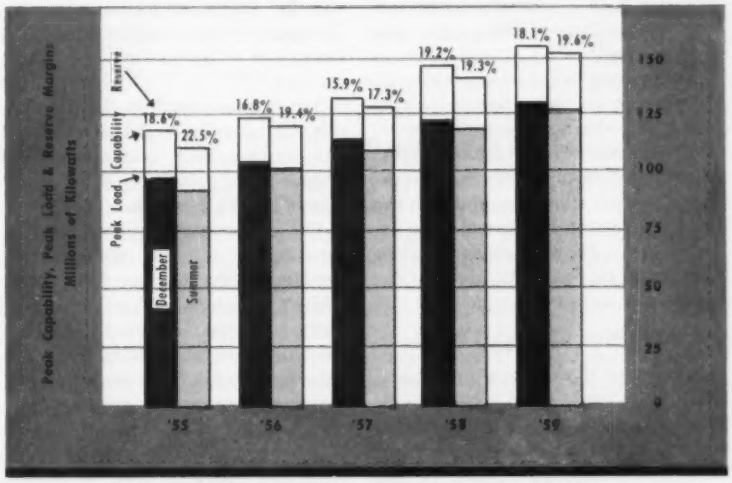
The South Central Region has a definite summer peak as a result of a growing air-conditioning load. This accounts for the abnormally high December reserves in Region 5.

The power survey also presented findings on the status of production of heavy electric power equipment. These are reported in Manufacturers and Markets, page 224 of this issue.

EEI's Survey shows U. S. energy output on the climb . . .



. . . and safe national margins for December, summer peaks



. . . comparison of summer and December peak loads shows leveling tendency

Summer Peak Loads (Thousands of Kw)

	1956		1957		1958		1959	
Region	Summer Peak	% of Dec.	Summer Peak	% of Dec.	Summer Peak	% of Dec.	Summer Peak	% of Dec.
I	21,594	92	22,969	92	24,497	93	26,077	94
II	19,021	94	20,603	93	22,199	94	23,734	94
III	18,165	91	19,355	90	21,301	91	22,947	90
IV	12,251	96	13,019	97	13,897	97	14,809	98
V	10,663	127	11,881	128	13,161	130	14,623	132
VI	2,101	94	2,386	95	2,619	95	2,841	96
VII	7,867	87	8,651	88	9,238	88	9,788	88
VIII	9,628	100	10,496	101	11,207	101	11,862	102
Total*	101,290	96	109,360	96	118,119	97	126,681	97

*Values for total U. S. are sum of regional totals and do not reflect the fact that maximum loads occur in December for most regions.

Wheeling Pact Ends Clark Hill Hassle

- Georgia Power signs 10-year agreement to wheel energy from project to preference customers; 120,000-kw "dependable capacity" involved

- Preference customers will contract individually with government for power; government will pay utility to wheel with rate tied to distance

The six-year long controversy over disposition of power from Clark Hill Dam in Georgia ended recently with the signing of a wheeling agreement between the Interior Department and Georgia Power Co.

Under terms of the 10-year contract, the government agrees to pay Georgia Power for wheeling energy to preference customers. These customers must contract individually with the government for their allotments and with the company for the balance of their requirements. The government does not contract to supply all the needs of the preference customers.

Pact Clarifies Georgia's Share

Signing of the contract in Atlanta, Ga., was announced by Fred G. Aandahl, assistant secretary of Interior. It removed from the limbo of negotiations Georgia's share of the power generated at the 280,000-kw Clark Hill plant constructed by the Army Corps of Engineers on the Savannah River, 22 miles upstream from Augusta, Ga.

Power from the plant is divided equally between the states of Georgia and North Carolina. The Georgia half will be fully integrated with the Georgia Power system, assuring Georgia of 120,000 kw of "dependable capacity."

The contract specifies that dependable capacity up to 80,000 kw and 325.5-million kwhr annually will be allocated and sold to preference customers by the government.

The government pays the company for wheeling at a rate per kwhr depending on the distance from Clark Hill to the customers' points of delivery on the company's system. Georgia Power must purchase, if available, up to 40,000 kw and may buy any non-dependable capacity and energy available to Georgia.

The company also agrees to supply preference customers with "deficiency energy" as well as their additional requirements. Deficiency energy is supplied when power being generated at Clark Hill drops below that specified in the contracts between the government and preference customers.

Payment for deficiency energy and additional capacity and energy, needed by the customers, is made direct to the company by the preference customers.

Initial term of the contract extends from May 20, 1956, to June 30, 1966. The contract is automatically renewable for successive five-year terms unless terminated by either party with notification not less than three years before the end of the term.

Issue Was Power Ownership

From time to time during the period of contract negotiations, which started in 1950, tempers boiled. At issue was the question of who should get title to the power.

Under previous proposals the government would have sold power direct to Georgia Power, and the company would have delivered it to preference customers in accordance with government allocations, instructions, and rates. This procedure would have maintained the established customer-company marketing relations.

Major Points in Clark Hill Contract

Contract, recently signed between the Interior Department and Georgia Power Co (above), involves half of the power at Clark Hill Project or a dependable capacity of 120,000 kw and estimated energy of 350 million kwhr in a normal water year. High spots of the agreement follow:

Preference customers get first 80,000 kw by contracting with the government individually. This includes 325.5 million kwhr annually which represents the above energy minus 7% losses.

Georgia Power wheels the power and must take up to 40,000 kw and associated energy, if any. Dump energy and capacity above the dependable capacity can be purchased by the company.

Preference customers pay government for project power delivered at a composite rate of 6 mills per kwhr and pay the company for deficiency energy at 4 mills per kwhr and for additional requirements at normal company rates.

Government pays Georgia Power for wheeling project power at rate depending on distance of customers' point of delivery from project—1 mill per kwhr, within 100 miles of project; 1.75 mills, up to 150 miles; 2.50 mills, beyond 150 miles.

Georgia Power pays a demand charge of 75¢ per kw per month for up to 40,000 kw and an energy charge of 4 and 3 mills for associated energy, exclusive of dump energy.

The company's average rate for project energy is estimated to be 3.4 mills per kwhr. This is lower than the preference customer energy rate by an amount that is supposed to compensate the company for losses and wheeling on deficiencies during normal operation.

During short emergencies at the project the company will supply deficiencies at the project rate and will be reimbursed by the government for cost thereof. During emergencies in excess of 30 days company will supply deficiencies at regular rates.

At company's request and discretion of the government, up to three generators can be operated as condensers. Company pays $5 per generator 1 hr.

Preference customers argued that such a proposal would circumvent the preference clause because it gave the company title to the power. And there the dispute stood for several years.

First preference customers to sign contracts with the government for Clark Hill power were officials of Elberton, Ga., and Tri-County Electric Membership Corp, Gray, Ga. In all, 44 municipals and 37 co-ops in Georgia Power's service area are entitled to the power. It is anticipated that all contracts will be signed and in operation by July 20.

After signing for Georgia Power, Harllee Branch, Jr, commented: "We are glad a contract has been signed. Although our company sought a different type of contract—one we thought to be more in line with the traditional relationships between our company and the cities and co-ops—our only interest now is making this one work."

Branch also pointed out that only 70,000 kw can be transmitted over the existing line to the hydro plant. But new lines will be constructed, "with all possible speed," now that the contract has been signed.

Aandahl said that the agreement "constitutes a fair and equitable resolution of conflicting interests."

Explain Transformer Failures

GE investigators blame misplaced strand of conductor in low-voltage winding and failure of reactor insulation

General Electric Co engineers have reported that thorough examination of the two 100,000-kva, 330-kv transformers which failed at the Portsmouth (Ohio) Area Project of the Atomic Energy Commission (EW—Apr. 30, p 61) has confirmed that the primary source of the trouble did not involve the high-voltage windings.

Conductor Strand Blamed

The first failure occurred on Jan. 29, they said, as a result of a misplaced strand of conductor in the low-voltage, 13.2-kv winding, which after seven months of service short-circuited to an adjacent turn of the winding. The resulting circulating current extended the fault until the differential relay removed the unit from service. There was no failure of the high-voltage winding.

The engineers reported that the second failure, which occurred on March 11, was due to the reactor associated with the load-tap-changing equipment. The insulation separating the reactor core legs and yoke failed, permitting circulating currents to be established in the reactor core, which produced arcing at the contact point. Carbon was generated from the oil and insulation, and gas bubbles were evolved. These bubbles accumulated in the main high-voltage insulation structure, ultimately resulting in sufficient reduction of insulation strength to cause breakdown.

Units Slated for Return

"The two units are being repaired and are scheduled for return next month," said J. B. Monk, manager of GE's power transformer sales.

"The reactors in the six companion units," he added, "will be replaced as a precautionary measure, without charge to AEC. From our examinations, we are confident of the top notch quality of the basic design and construction of these high-voltage transformers."

Nuclear Power's Insurance Problem Aired

(*Continued from page* 114)

dent of Liberty Mutual Insurance Co, testified on behalf of American Mutual Alliance, an organization of 118 mutual fire and casualty companies. The alliance is now in the process of forming an atomic pool and is even accepting some applications for atomic insurance, Yount said, but rate-wise it has "only advanced far enough to agree on the need for some scheduled rating of risk."

Yount was just back from London, where he talked to British underwriters about the possibility of pumping foreign funds into the U. S. atomic insurance pool. In detail, he would not divulge the results of his mission, but Yount appeared doubtful that the pool available to U. S. firms will climb above the $50 million or $65 million —both figures have been used variously—in the very near future.

In talking about insurance, it soon became clear, the industry was most concerned about protection against public liability. Cisler said he believes "in the ability of (private insurance) resources to provide physical damage and workmen's compensation protection in adequate amounts and at reasonable rates for projects such as we contemplate."

Government Backing Welcomed

Searing put the same thought in these words: "We are talking about the kind of risk that is outside the bounds of reasonable probability and may be catastrophic in nature. To cover this special kind of risk insofar as it involves third-party (public) liability, some kind of government backing . . . to pay claims above those reasonably insurable would be welcome. . . ."

Francis K. McCune, vice president, General Electric Co, foresaw the fledgling industry being hung on "dead center" unless liability protection in adequate amounts at reasonable rates is provided.

Anderson seized the occasion to ask McCune if the industry is on dead center now. McCune responded, "I know of no program that is not going ahead . . . (but) on the assumption that this thing would be worked out."

Sen John O. Pastore (D-R.I.), who favors some limited amendment of the Public Utility Holding Company Act to help the new industry, asked McCune whether it would be necessary for the government to build "these reactors" if Congress settles insurance and amends the act.

McCune said he thinks the answer is negative. Pastore closed the exchange by observing that he considers the two taken together as "small concessions." Anderson, strong for federal indemnification as a solution to insurance, apparently is far from convinced about the need for tinkering with the Holding Company Act.

B&W Starts Fuel Element Production

Last week outside Lynchburg, Va., at its new nuclear facilities plant, Babcock & Wilcox Co received its first shipment of U-235 and began the fabrication of fuel elements for atomic reactors on a competitive commercial basis.

Here on a 520-acre site bordered on three sides by the C&O Railroad, the old Dominion Canal and the James River, B&W will carry on two vital phases of its nuclear activities—the fabrication of fuel elements, and critical-experiment work associated with the study and testing of reactor core components.

Initial operations at these new facilities will be devoted to the production of flat-plate type fuel elements and core assemblies. They will be centered in a fabrications building covering 32,000 sq ft provided with metal casting, rolling and machining equipment capable of a uniquely precise kind of laboratory-controlled production. Here the first job is the manufacture of a year's supply of 325 fuel elements for AEC's Materials Testing Reactor at Arco, Idaho. The first 35 will be delivered in August.

Second phase of operations at the Lynchburg facilities—those involving experimental work—will begin in a few weeks when the new critical-experiment facility is completed. Its first project will be to determine the nuclear characteristics of the Consolidated Edison Co of New York pressurized-water, thorium-converter reactor which B&W has contracted to design, fabricate, test, and erect at Indian Point, N. Y.

The first core assembly, made to one-quarter scale using fuel elements made at the near-by fabrication facility, will be tested at zero power level in the critical-experiment facility. Disposition of the nuclear fuel in the full-scale power reactor will be set by one or more of these low-power tests.

This critical-experiment facility, about 1,200 yards from the fabrication building will be completed soon. A reinforced concrete bay, nearly three stories high and with walls running up to 3 ft thick, forms the test chamber for critical assemblies. Offices, shops, a control room, laboratories, a fuel storage vault and fuel sub-assembly room, radioactivity counting room, and other units have been built in an adjoining wing.

While early activities at Lynchburg will involve existing contracts, Alfred Iddles, president of B&W, told a technical press group visiting the facilities that the entire unit has been designed to manufacture and test a broad range of present and future reactor and fuel element types. Provisions have been made, he said, to add facilities necessary to make pin, rod, and cylindrical-type fuel elements as well as the flat plate types now made.

On the day the fabrication facilities start production initial steps will be taken, Iddles said, to triple the existing production area. This expansion, he said, should be completed by November.

Other Plants Work for Atom

Iddles explained that many of the company's plants, including the new one at Lynchburg, will contribute to the construction of a single nuclear power assembly. The Con Edison reactor pressure vessel will be made at the company's Barberton (Ohio) works, pressure tubing in Beaver Falls (Pa.), and other components will come from B&W plants elsewhere.

Harold L. Price, director of the Division of Civilian Application of AEC told the technical press group at Lynchburg that "efforts of B&W and others will go a long way to get government out of the atomic business."

In outlining the place of government in the atomic supply business, Price made two points:

- Government must remain in the atomic supply business to meet the demand of the military for weapons. This engenders fear, he said, that the government will use its facilities to compete with private industry.
- Government may use its facilities to foster development of peaceful uses of atomic energy. It may be necessary for the Commission to furnish essential services to foster growth of atomic applications, he said.

AEC's Dilemma

Charges for such services must be carefully set, Price said. If they are too high it will discourage the private power industry. On the other hand, if charges are too low, it will discourage the private manufacturing industry from taking over such services from the government.

Industry can resolve this government dilemma by moving in and getting in a position to furnish these services. In this connection Price hinted that in view of the activities of Babcock & Wilcox and others the AEC is just about in a position to say that it will no longer fabricate fuel elements.

B&W's NUCLEAR FACILITY started up last week at Lynchburg, Va. First job is fuel elements for MTR reactor of AEC at Arco. Nuclear experiment facility, not shown, will test reactor components for Con Edison atomic power plant

R. W. FENTON, outgoing president of Public Utilities Advertising Association, hands gavel to successor, R. H. Bridges (r)

PUAA Hears Vennard Ask More Information on Government Power

The electric utility industry has made considerable progress in its public relations activities, particularly in making available the facts regarding the dangers of government encroachment. However, there is still much to be done. More of us should share in the work of the industry's national associations. We should do more in informing our employees and the public locally.

These were some of the observations made by Edwin Vennard, vice president, Edison Electric Institute, to the Public Utilities Advertising Association's 35th Annual Convention in Philadelphia, May 10-11.

Despite the fact that a substantial majority of the American people are opposed to government operation "the government is still making some progress in encroaching in the power field," said Vennard. "This is a matter worthy of the continued concern of top executives."

Individual Freedom Cited

Vennard pointed out that the government power issue is but a part of a greater problem having to do with individual freedom. In tracing the history of the expanding freedom of the individual from early Christian times to the founding of the United States, he pointed out that the Declaration of Independence was inspired by the conviction that the individual gets his freedom from his Maker and that "the government was formed primarily for the purpose of protecting man's right to work out his own destiny as long as he respects the rights of others. Thus man freed himself from government domination," he said.

He implied that the basic sales appeal of Communism, Fascism, Nazism and other forms of dictatorships and nationalization lies in the fraudulent merchandising of the fallacious proposition that the people should let the government take care of them. A concept, he noted, that leads to an exchange of birthrights for bowls of pottage.

Dangers of Government Giving

America's danger is not so much that of Communists coming over and shooting us or of Communists taking over from within—"our danger is that we may gradually adopt one of these foreign concepts of government, under some other name. Our danger lies in Americans who call upon the government to do for them those things which they can and should do for themselves as individuals. People are shopping around in government for the best bargain they can get, possibly not realizing that the government has nothing to give to anyone except that which it takes by force from someone else."

"Studies and surveys have indicated," the EEI executive continued "that there is a correlation between the public's lack of knowledge of economic facts and the public's desire for the government to take over. In the power business we have found that one of our greatest responsibilities is to give the public the facts about our business and especially the facts relating to the government power issue.

"We still find the public uninformed on the tax discriminations and the preference clause. Few people realize what these injustices mean to them.

TVA Sells at Half Price

"Take Tennessee Valley Authority as an example of government power. It pays no interest on the approximately $2 billion that the Congress has donated to it. It pays no federal income taxes. If TVA were required to pay the market price of money and taxes as the power companies are required to pay, then TVA would have to double its rates to break even. It is not that TVA makes cheap electricity; it's just that TVA sells electricity at half price.

"The people of Philadelphia probably don't know that they are being taxed so that the people of Tennessee can heat their houses electrically at half-price. They don't know that TVA sells electricity at half-price to lure industries that might otherwise locate in Philadelphia.

"People don't know that the 80% of the American citizens who get their power from the power companies are being taxed so that the 20% who buy their power from a government agency

(*Continued on page* 258)

Exciter without commutator or brushes, at right, installed on 35 MW turbine-generator

Commutator-Less Exciter Works Well

GENERATION
Operation

Modernizes excitation responses to match newer unit with rotating amplifier type excitation control system

W. C. KALDENBERG Electrical Engineer, Power Station Engineering Division, Iowa Power & Light Co, Des Moines

A unique new commutatorless excitation system has been in successful use for a little more than a year on a 35-Mw turbine-generator at the main power plant of the Iowa Power & Light Co near Des Moines.

The generator with which the system is associated was installed in 1938. It is a 3,600 rpm, 0.8 pf unit and originally had a 250 hp motor-driven exciter.

Change to the commutatorless exciter system was made when station generation was split between two buses. At that time a newer 40-Mw unit with a modern direct-driven rotating amplifier excitation control was put on one bus and the 35 Mw unit on the other.

It appeared that the 35-Mw unit should be modernized to provide about equal excitation response on the two generator buses. A direct-driven exciter was desired to replace the motor driven exciter. But the 35-Mw size, coupled with the 3,600 rpm speed, made it difficult to secure a conventional direct driven exciter with rotating amplifier excitation control. There was also the problem of space and support needed for installation of a conventional direct-driven exciter on this unit.

In the search for a suitable exciter, information was obtained on the new commutatorless exciter which, based on developmental information available, would have the response characteristics desired and would be unusually rugged and reliable.

The exciter is a direct-connected type. It is a three-phase inductor alternator with 12 poles. With the rotor revolving at 3,600 rpm the alternator output is at 360 cycles. There is no coil on the rotor. Both coils are on the stator. One is supplied with dc excitation from a selenium rectifier. Ac voltage is generated in the second coil by the changes in flux caused by passage of the poles of the rotor through the magnetic field. The current generated by the exciter goes to the selenium rectifier where it is converted to dc and fed into the field circuit. The main generator field and the inductor-alternator field coils are in series. The power rectifier is the selenium full-wave type and is divided into modules which are individually fused.

The power amplifier is a variable reactor large enough to load the inductor alternator with enough var output to hold down the voltage to the value required for proper field current.

The inductor alternator is made to have unusually large voltage regulation. Although it maintains voltage rather well with the rectifier load alone, there is a large voltage drop almost instantly when the reactor load is applied. Very fast and accurate control of the reactor is provided. This provides a very fast changing excitation system which could only be equaled by vacuum tube rectifiers.

Based on paper presented at the Missouri Valley Electric Association, Engineering and Operating Conference, April 20, 1956

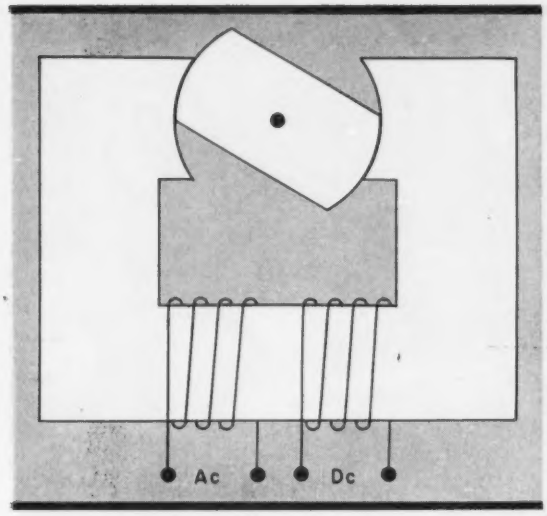


FIG 1 BOTH COILS of the exciter are on stator. One is supplied with dc from rectifier; voltage is generated in the other and the current is fed into the rectifier circuit

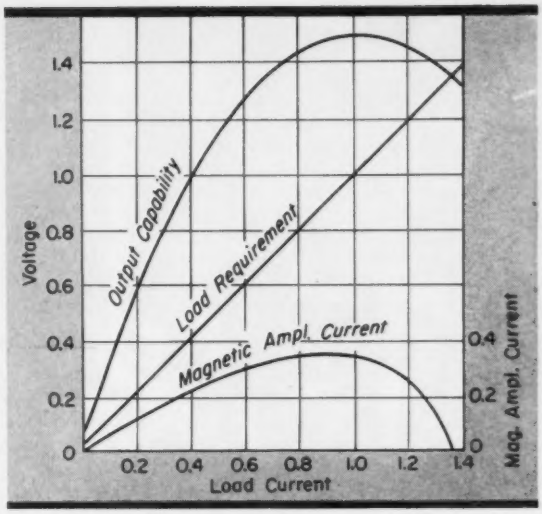


FIG 2 OUTPUT CAPABILITY of the inductor-alternator exceeds the load requirements until requirement is 38% above rated load, as is shown by these characteristic curves

Circuit arrangement for the excitation system is shown. To regulate generator voltage, potential is measured at the terminals of the three phases and the current is measured on one phase. Voltage level is set by the automatic voltage adjuster.

The comparator is a network assembly of saturable transformers, capacitors, resistors and rectifiers. These are arranged so that if a three-phase voltage in the order of 100 volts is impressed on the assembly, a zero dc voltage output signal results. However, if the input voltage departs a small fraction of a percent, a strong output signal results. A high input signal produces a buck signal and a low signal produces a boost signal. Output of the comparator goes to one of the control windings of the pre-amplifier. These equipments and their functions are similar to those in all modern automatically controlled excitation systems. The differences are minor.

The inductor-alternator, characteristics are different from the familiar curves of conventional alternators, but do retain some similarities. Since there is a series field current, the abscissa is the load current and the field current. Load requirements are shown as a straight line because the circuit is essentially of constant resistance. Output capability is above load requirements by 50% at rated load and voltage. At 60% of rated load, capability is more than 100% above the requirements. This is desirable because of the need for having more powerful responses at the lower field currents.

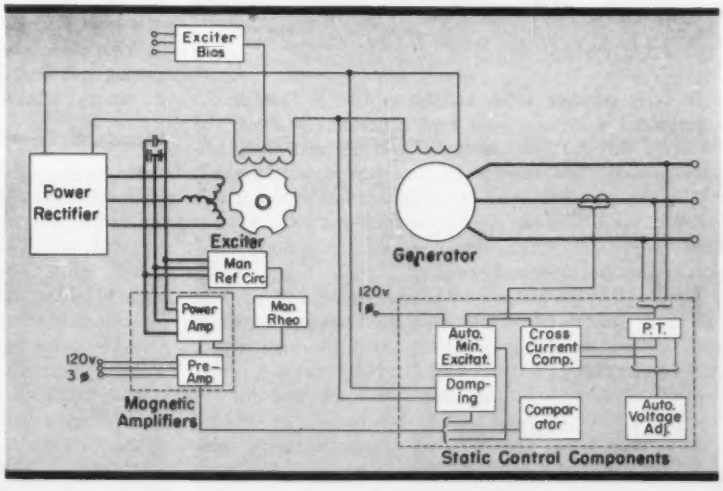
The exciter sets a definite ceiling voltage and current where the output capability and the load requirement curves cross. The output capability was increased and the rectifier performance improved by putting a fixed capacitor across the output of the inductor alternator.

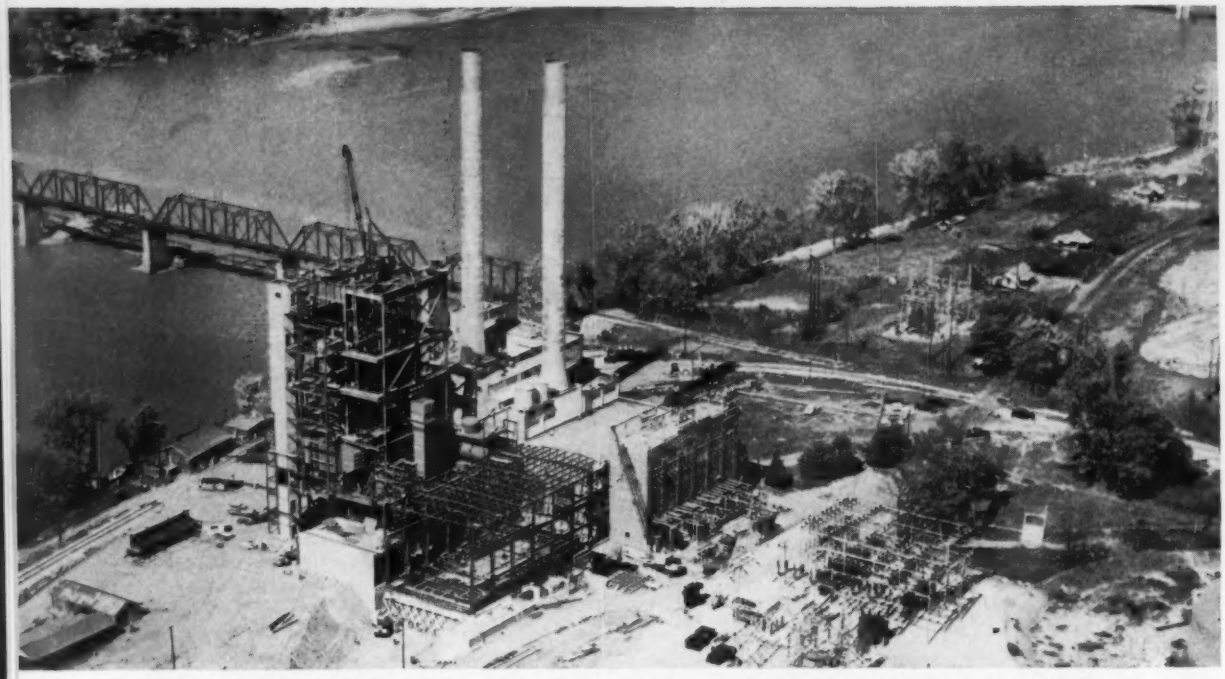
The exciter will operate reliably and simply in manual control. The pre-amplifier requires an outside source of power. But loss of this power does not disturb the voltage control unduly. A manual reference circuit is established by a network of resistors, transformers and rectifiers. The transformers are operated above the knee of the saturation curve and a fairly constant output voltage is obtained for a variation in range of 50 to 350 volts in the 360-cycle voltage input.

The manual reference circuit output feeds into one of the two control windings of the power amplifier and

(*Continued on page* 252)

FIG 3 EXCITATION SYSTEM is connected as shown with field coils on inductor-alternator in series with generator field coil. Rectifier supplies both field coils and current generated in inductor—alternator is fed into the rectifier





Coordinated design, construction, and manufacture added 170 Mw to Riverbank in 22 months

Spurred by mounting summer air conditioning loads . . .

OG&E Adds 170-Mw Unit in 22 Months

GENERATION
Design

Carefully coordinated design and construction coupled with selection of proven equipment designs puts 170-Mw unit in trial operation at Riverbank plant in 22 months

R. F. DANNER, Manager, Engineering and Construction, Oklahoma Gas & Electric Co., Oklahoma City

A. R. LE BAILLY, Partner, Sargent & Lundy, Chicago

In early summer 1954, Oklahoma Gas & Electric Co experienced a system peak load considerably above the predicted demand because of hot weather and air conditioning load. Forecasts for 1955 and 1956 were revised. A 100-Mw unit, scheduled for operation in 1955, that was sufficient for 1955 loads proved too small for 1956. Also, it became apparent that the next new unit should be in operation before the 1956 summer peak.

Load and system capability studies completed on July 16, 1954, indicated that the unit should be approximately 150 Mw and that it should be located in the eastern part of the system. A 170-Mw unit was chosen because it would provide capacity for an estimated two years' load growth. Riverbank Station was selected as its location.

But much work remained to be done before the unit could be placed in service. It was apparent that the usual schedule would have to be accelerated and some short cuts would have to be taken.

What steps were taken and how design contributed to getting this unit into trial operation in May 1956, just 22 months after release of engineering is told here.

Standard Equipment Specified

Under the accelerated schedule, excavation was started in November 1954 so that construction could be done with minimum overtime and double shifting. To start at this early date, it was necessary to expedite engineering and design work. For this reason, major equipment was selected from proved, existing designs to avoid delays in engineering and to permit earlier release of manufacturing. By adhering to this policy, the company was able to buy the turbine generator, boiler feed pumps, feedwater heaters, fans and other equipment within 30 days after the release of the engineering work on July 22, 1954.

The new turbine is a tandem compound, double flow, 1,850-psig, 1,000F superheat, 1,000F reheat unit rated

Construction Timetable for Riverbank No. 3

7/22/54	Decided to accelerate schedule
7/28/54	Agreed on rating, characteristics, some details
8/2/54	First meeting with boiler manufacturers
8/3/54	First meeting with turbine-generator makers
10/14/54	Started preliminary fill and grading
5/16/55	Air heater delivered
6/6/55	Gas recirculating fans delivered
6/24/55	Forced draft fans delivered
7/12/55	Boiler drums delivered
8/11/55	Condenser delivered
8/12/55	Started erection of condenser
8/16/55	Started erection on forced-draft fans
8/18/55	Started erection of gas recirculating fans
8/24/55	Started erection of boiler drum
11/7/55	Turbine sole plates delivered
11/15/55	Started installation of sole plates
12/26/55	Generator delivered
12/28/55	Started installation of generator
1/11/56	Generator stator set on foundation
1/19/56	Turbine delivered
2/1/56	Started installation of turbine
6/1/56	Unit scheduled to be in service

at 170,000-kw maximum capacity at two inches of back pressure.

Generator rating is 192,000 kva, 0.85 pf, 0.64 SCR, 18 kv, 3,600 rpm, 30-psig hydrogen pressure. There are two separate motor driven exciters, each rated 500 kw, 375 v, 900 rpm.

Basic design of the boiler is similar to the boiler now in service at OG&E's Mustang Plant but with an increase in furnace width required for the large boiler capacity. Design is for an output of 1,200,000 lb per hr.

To expedite the control equipment of the boiler and prefabrication of the instrument boards, the combustion control and instrumentation are a duplication of the equipment now in service at OG&E's Mustang Plant. The existing centralized control room had adequate space for this unit as well as a future unit of a similar size.

Boiler erection time was reduced by fabricating furnace walls on the ground during erection of boiler support steel. Prefabricated panels, as long as 90 ft, were raised into place as complete boiler wall units.

The feedwater cycle consists of three low-pressure heaters, one deaerating heater, and two high-pressure heaters which receive extraction steam from extraction openings located in the intermediate-pressure and low-pressure turbine casing.

Three boiler feed pumps, each slightly above half capacity, were installed, complete with variable speed control through hydraulic couplings. Pump speed is controlled directly from the three-element feed-water regulator.

The condenser is a two-pass 80,000 sq ft, 72,000 gpm unit complete with backwashing facilities, three half-size condensate pumps, and steam air ejectors.

Demineralizers Chosen

A 2½-mile pipe line was laid to obtain Muskogee city water for boiler feedwater because treatment required for city water was much less than that for the existing water at the site. City supply was considerably more economical.

Demineralizing water treatment was chosen because it provides better assurance of silica removal and permits building up water reserves before putting the plant into operation. The demineralizing plant is adequate in emergencies to treat deep well water available at the site with more frequent regenerations.

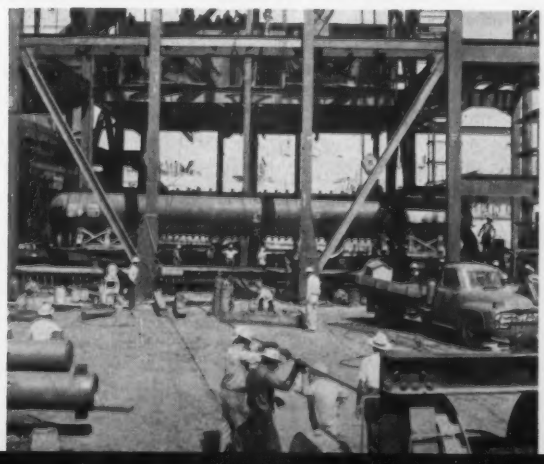
Riverbank Plant is located near Muskogee on the Arkansas River, beyond the confluences of the Verdigris and Grand Rivers. The old plant consists of a 7,500-kw unit and a 15,000-kw unit installed in 1924. Since the Pensacola dam completion in April 1951, the minimum river flow has been 89,760 gpm. River level has varied 42 ft between extreme low and high conditions.

Since some recirculation of condenser cooling water may occur under extreme low flow conditions, maximum separation was provided between the intake and the discharge and the circulating water requirements of the new unit were reduced by using a two-pass condenser.

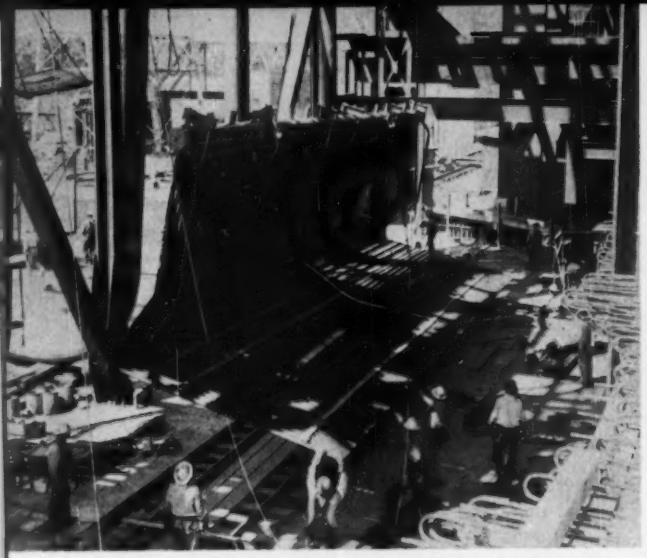
Circulating Water Tunnel Changed

The circulating water tunnel for the two existing units was divided by a center wall and run the entire length of the plant under the turbine room basement. Half the tunnel was used as the intake, the other half as the discharge returning water to the river only a short distance down stream from the intake. By using both suction and discharge sections as a single intake tunnel and extending

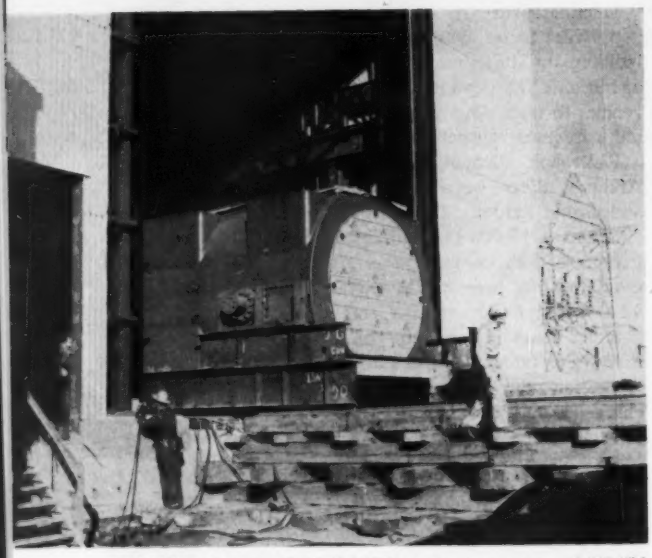
BOILER DRUMS arrived 7/12/55, erection started 8/24/55



BOILER WALLS were assembled on ground, to speed schedule

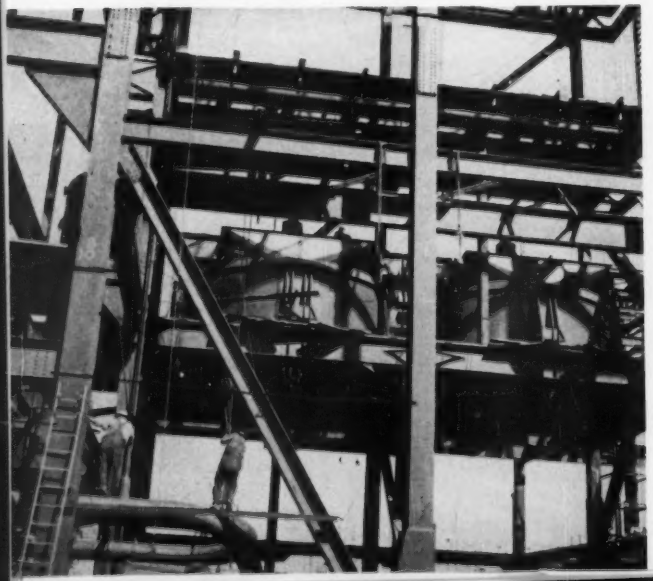


BOILER WALLS were raised inside structure with crane



GENERATOR arrived 12/26/55; stator was set on 1/11/56

AIR PREHEATERS were installed on 8/31/55



it to the new unit, the circulating water supply was adequate for both the present units and the new unit.

New discharge piping was installed for each unit to new seal walls. This provides maximum separation between intake and discharge to minimize recirculation.

Elimination of a new intake crib and tunnel greatly reduced construction cost and time which was particularly important in view of the accelerated schedule.

Quick-Change Fuel System

Normal fuel for the present is natural gas, supplemented by fuel oil from the existing fuel oil storage facilities available at the site. Provisions were made for rapid conversion to pulverized coal firing. All pressure parts of the furnace were installed so that conversion will be limited to the addition of pulverized coal and burners, soot blowers, and ash disposal system. The design was arranged so the addition of the coal bunkers, pulverized fuel equipment, and coal handling facilities can proceed without interfering with the operation of a boiler and will therefore minimizing shut down time for changing fuel.

The boiler is of the outdoor type and forms a part of the building. The turbine room was designed to use the existing crane which has a span of 58 ft and was originally installed to serve the 15,000 and the 7,500-kw units of the old plant. A dolly-type auxiliary hook of 15-ton capacity was added to the existing crane bridge without jeopardizing the original crane clearances or flexibility. The new turbine is located in the turbine room extension with its longitudinal axis parallel to the crane runways.

Motors for station auxiliaries are either 4,160 or 440-v, depending on the size of the unit. A 208/120-v system supplies lighting and miscellaneous small power.

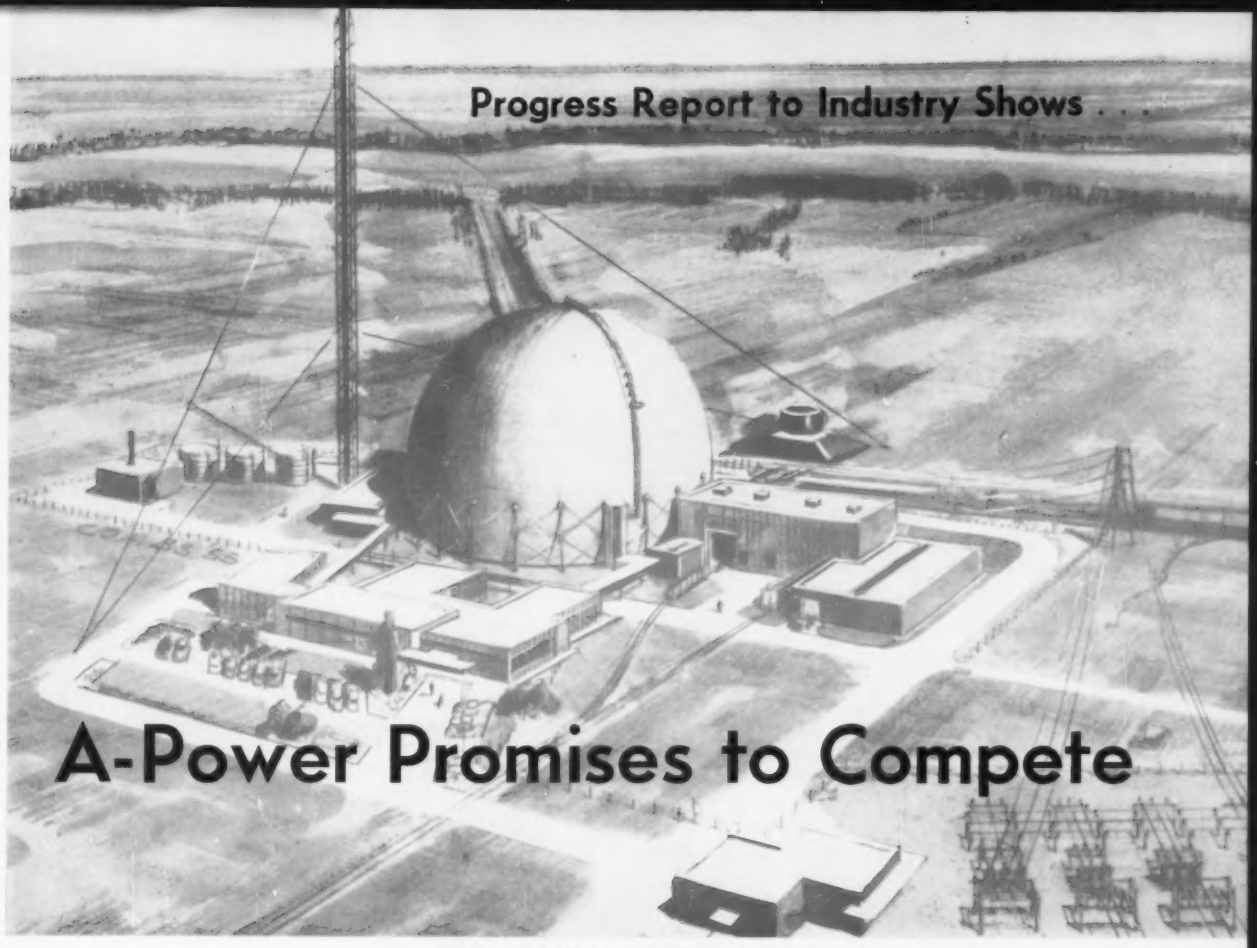
To conserve building space, the 4,160 and the 440-v switchgear were located on the roof of the machine shop, and the 208/120-v transformers and air conditioning unit were placed outdoors on the control room roof.

Connection to the 161-kv system is through isolated-phase bus and a single 180,000-kva, FOA type, 3-phase, step-up transformer.

A considerable amount of transmission and substation work, including about 115 mi of 161-kv circuit, three new 161-kv substations and two new 66-kv substations, was necessary to integrate the new unit into the system. However, by taking full advantage of the quick delivery schedules of manufacturers, this work was completed before the hot weather began in 1955.

Close Liaison Essential

An extremely high degree of liaison was necessary at the design level between utility, consultant, and manufacturers' engineers to make the schedule on transmission and substation work. It was necessary to reduce sharply the time spent in submission of manufacturers' drawings for approval, including the time usually spent in checking, reviewing, and transmitting them. To do this and still avoid construction delays due to drawing errors, while maintaining the high quality inherent in previous installations, most of the outline drawings of major equipment were approved directly on the drafting board at the manufacturer's plant. Substation structure assemblies were discussed in face-to-face meetings between the manufacturer's engineers, utility engineers, and consulting engineers. Resultant marked-up drawings and sketches became the pattern for preparation of final drawings.



Progress Report to Industry Shows . . .

A-Power Promises to Compete

JOHN J. KEARNEY, Associate Editor

Much has been written in the technical press in the past few years about atomic energy. Much more has been written in the daily newspapers. What does it all mean? What has been proved? What hasn't?

On the following 23 pages Electrical World brings you up to date on the atom.

This report traces the significant steps of progress and includes today's status of this new form of energy. It analyzes the various reactors now under consideration as power sources for the generating plants of tomorrow—describing their advantages and disadvantages in the utility man's language. Also included is up-to-the-minute data on the proposed nuclear plants in chart form for easy reading.

Costs, one of utilities' first considerations, are established within the limits of today's knowledge and experience. The report can't give a fixed-price quotation. But it does develop in a logical sequence a basis for future considerations.

Turning to the future, the report discusses the role of fusion reaction. And the pulse of the industry was taken with a round-up of utility experts' opinions on the problems in the nuclear field.

The Special Report Presents . . .

1. Significant steps of progress . . . . . page 128
2. The status of reactor technology . . . . . page 129
3. Eight reactors compared . . . . . page 132
4. Details of atomic power projects . . . . . page 138
5. Estimated energy costs . . . . . page 142
6. Fusion as a source of power . . . . . page 146
7. Comments of industry experts . . . . . page 149

Nuclear Power Is Here To Stay

- **In the short span of 15 years nuclear energy has passed from the laboratory to use for power generation. Utilities play big role**
- **Here in chronological order are the important steps in the transformation of A-power from a weapon of war to an instrument of peace**

1942

AUGUST—Manhattan District established within the U. S. Army Corps of Engineers to produce atomic bombs.
DECEMBER—First self-maintaining nuclear chain reaction induced in an atomic pile at Stagg Stadium, Chicago.

1945

JULY—World's first atomic bomb detonated at New Mexico.
AUGUST—Atomic bombs dropped on Japan.

1946

APRIL—Manhattan Engineering District announces program for experimental development of atomic power.
JULY—Joint Army-Navy atomic bomb tests at Bikini.
AUGUST—First (McMahon) Atomic Energy Act becomes law. Atomic Energy Commission is created.

1947

MAY—AEC Laboratories undertake power reactor studies.
OCTOBER—Industrial Advisory Committee created to advise on possibility of industrial participation.

1948

General Advisory Committee reports that first generation of atomic power plants will be small and uneconomical.

1949

JANUARY—Industrial Advisory Committee reports that there is no immediately profitable fields in atomic energy program except radioisotope work. Recommends publishing non-secret data and more security clearance for industry.
FEBRUARY—Division of Reactor Development organized in AEC to carry out long range reactor development program.
AUGUST—Advisory Committee on cooperation between Electric Power Industry and AEC to examine progress and technical information in reactor development.
SEPTEMBER—President announces first USSR atomic explosion. AEC plans to build material testing reactor.
NOVEMBER—AEC authorizes experimental breeder reactor.

1950

FEBRUARY—Oak Ridge school of technology opened to provide training for engineers in reactor development.
AUGUST—Brookhaven pile, U. S. biggest, begins operation.
OCTOBER—AEC approves low-power research reactor for North Carolina State College.

1951

FEBRUARY—Detroit Edison Co, Dow Chemical Co, and Monsanto Chemical Co suggest industrial study groups investigate feasibility of atomic power.
MAY—Four industrial study groups, Detroit Edison Co, Dow Chemical Co; Monsanto Chemical Co, Union Electric Co; Commonwealth Edison Co, Public Service Co of Northern Illinois; and Pacific Gas & Electric Co, Bechtel Corp, approved by the AEC.
DECEMBER—Electric power (100 kw) generated from heat of breeder reactor at Argonne National Laboratory.

1952

SEPTEMBER—Successful breeding accomplished at AEC's Arco facilities. AEC authorizes Pioneer Service & Engineering Co and Foster Wheeler Corp to make a 12-month study of feasibility of power reactors.
NOVEMBER—U. S. explodes first H-bomb.

1953

APRIL—Atomic Industrial Forum, first industrial atomic energy association, formed.
JULY—First full-scale atomic power plant authorized by AEC. It will produce 60-Mw of electricity and use pressurized water reactor.
AUGUST—Russians test H-bomb.
DECEMBER—Eisenhower proposed international A-pool.

1954

MARCH—AEC announces a five-year atomic power program (Reactor Development Program). Duquesne Light Co goes into partnership with AEC to develop 60-Mw pressurized-water reactor power plant. (See July 1953.)
JUNE—Russia announces operation of a 5-Mw nuclear plant.
AUGUST—Atomic Energy Act of 1954 passed.
SEPTEMBER—Eleven New England Utilities organize Yankee Atomic Electric Co. Ground broken for Duquesne PWR reactor plant at Shippingport, Pa.

1955

JANUARY—AEC announces Power Demonstration Reactor Program. The Commission will offer developmental assistance, use of AEC laboratories, and waiver fuel price for 7 years to groups that will build nuclear power plants. Deadline for applicants—April 1. Consolidated Edison Co of N. Y. asks bids on privately financed 200-Mw nuclear plant.
APRIL—Utility industry submits four proposals under AEC Power Demonstration Program.
JULY—Insurance study group concludes that atom is insurable. Electric power produced by AEC reactor at Arco, Idaho, and submarine intermediate reactor at West Milton, N. Y.
AUGUST—International "Atom For Peace" Conference held at Geneva, Switzerland. U. S. reveals it is studying peace time use of thermonuclear energy.
SEPTEMBER—AEC issues its second invitation under the Power Demonstration Reactor Program for proposals to develop, design, construct, and operate small power reactors.

1956

FEBRUARY—McKinney Panel appointed by Congressional Joint Atomic Energy Committee submits its report. Seven proposals submitted under second round of AEC's Power Demonstration Program.
APRIL—AEC announces Arco reactor accident occurred Nov. 29. Core was destroyed in mishap caused by human error.

Kenneth Davis Says This About Reactors Today:

There is absolutely no question about the technical feasibility of building nuclear power reactors.

The expected life of the nuclear boiler is . . . a pertinent consideration and one which may need the longest time to decide.

Economic studies . . . have shown that . . . competitive nuclear power is possible if . . . development programs are successful. This is important because . . . it is not a necessary conclusion.

Markets for radioactive waste materials may develop. If they do, they will help pay for the processing cost.

Fuel element designers and chemical processors are working at cross purposes in many cases.

It is much more difficult to estimate operating costs today than it is construction costs.

Each individual reactor concept has its advantages and disadvantages.

There are "better" reactors than those now conceived and . . . these will eventually be developed.

Power Reactor Future Is Bright

- Technical feasibility has been proven. Construction and operating experience will help reduce costs and make atomic power competitive
- Reactor technology is well advanced. The different available types however must now be tested. Future may reveal new reactor concepts

W. KENNETH DAVIS, Director of Reactor Development, United States Atomic Energy Commission, Washington, D. C.

The prospects for the utilization of atomic energy to produce economically competitive electricity appear brighter today than they have at any time since man first achieved a self-sustaining chain reaction somewhat more than 13 years ago.

Power Reactors Are Feasible

There is absolutely no question about the technical feasibility of building nuclear power reactors. This can confidently be said even though our first fullscale power reactor, the PWR at Shippingport, Pa., is not yet in operation. In fact no new major discoveries appear to be necessary to achieve economical nuclear power. However, major inventions will be required if nuclear power is to be not only competitive but very substantially cheaper than power from conventional sources.

Nuclear power faces very difficult competition in most areas of the United States. Modern conventional power plants are relatively cheap to build, efficient to operate, and run on large reserves of comparatively cheap fuels. Further improvements are to be expected, and it is likely that some of the technology resulting from the pursuit of nuclear power will assist the conventional power plants as well.

Nevertheless, designs of large power reactors can be started in the near future, certainly within the next two or three years, which when built would be economic in operation in important areas of the world.

Small power reactors are relatively more expensive than small conventional power plants especially when operated at low load factors. For this reason, small reactors which may be built to gain experience with reactors and their operation cannot be expected to make important contributions to the economies of undeveloped countries for some years to come.

Power Has Been Produced

Useful electrical energy, was first achieved in the United States at the Experimental Breeder Reactor at Arco, Idaho, in December 1951. Since then electric power has been produced by the Homogenous Reactor Experiment at Oak Ridge, the BORAX III at Arco, and the Mark A SIR Prototype at West Milton, New York. In addition, very substantial quantities of mechanical power have been produced by the Mark I STR at Arco, the Mark II STR in the submarine NAUTILUS, and the Mark A SIR at West Milton.

In most cases actual production of electric power does not add very much to the technology. But in some cases, such as the Boiling Water Reactor Experiment, generation of power is important because of control problems and, in this case, the questions of operating and maintaining the turbogenerator when it is exposed to radioactive steam. In general, if the reactor coolant can be obtained at a high temperature, there is little question about the possibility of being able to generate electricity from this heat by conventional means and at a relatively well understood cost.

The question thus reduces to one of the cost of designing and building the nuclear boiler and the cost of operating it once built. The expected life of the nuclear boiler is also a pertinent consideration and one which may need the longest time to establish on an acceptable basis.

Some Studies Useful

Many economic studies have been made by a great variety of groups—some who knew what they were doing and many more who did not. Some were on a realistic basis; many more were not. Suffice it to say that

today the average economic study is a very unreliable guide.

However, the economic studies which have been made and especially the more sophisticated ones have been useful for one thing—to show that there is no fundamental reason why economically competitive nuclear power is not possible if the development programs are successful. This is an important point because it is not a necessary conclusion. Such studies, however, are totally inadequate to demonstrate which types of reactors are going to be the best or how long it is going to take to arrive at economical nuclear power.

Cost Only Tentative

The cost estimates of the proposed large power reactor plants are only tentative, but they do indicate that large (100 to 250 Mw) plants can be designed within the next year or two which will cost no more than 50 or 75% more than a comparable conventional power plant. If the cost of fuel charge is included, the investment is about twice as much.

While this is high, it is encouraging because the first large nuclear power plant is not yet operating. There are many reasons why the costs of later generations of nuclear power plants can be expected to decrease markedly. Some studies have claimed that there is no reason why a nuclear boiler should utimately cost any more than a conventional boiler. The basis for this claim is that designs will be simplified as the result of operating experience, the capacity of units will be increased, better and cheaper methods of construction will be developed, and costs will be reduced by repetitive manufacture and the increased volume of work.

Plants Must Be Built

It is not possible to tell how much it is going to cost to build a nuclear power plant without actually designing and building it. Further, the cost of successive generations of nuclear power plants is not going to be reduced until the first plants are built.

It will take a long time to establish the life of a plant and its components. We believe that reactor power plants can have useful lives substantially the same as conventional power plants, but there are many unknowns which take time to evaluate either experimentally or in large operating plants. Our experience on operating reactors goes back only about ten years. And power reactors are going to operate under more severe conditions than reactors now in existence do.

What is Russia Doing?

Russia is in much the same position as the United States with respect to conventional fuel reserves. It too has entered into an agressive nuclear power development program. The Russians have recently announced that by 1960 they plan to have large-scale versions of at least ten different power reactor concepts. By then their total nuclear power generating capacity is expected to be between 2 and 2½ million kw. This is indeed a large and vigorous program—one that not only indicates their belief that nuclear power can be made "competitive" under their system but one that gives us concern in race for technical supremacy.

Load Factor May Be Low

Cost of operating a nuclear power plant is a very critical item, for regardless of the cost of building the plant, it is not likely to be operated with a high load factor unless its operating costs are equal to or less than those for conventional plants.

The cost of nuclear fuel consumed less the value of fuel-grade plutonium produced is less for large reactors having reasonable conversion ratios than the cost of conventional fuels in all except the very cheapest fuel cost areas of the United States, if only that part of the operating cost which is associated with the consumption of the nuclear fuel is considered. This is an interesting and valuable conclusion because the cost of recovering uranium and enriching it might have come out to be so high that competitive fuel costs could be achieved only with advanced types of reactors such as breeders—or perhaps not at all!

However, we still have the cost of fabricating the fuel elements, the cost of processing them when irradiated, and the costs of waste disposal. All are actually a part of the fuel cost.

Manufacturing fuel elements for most reactors is still very expensive particularly when large amounts of very expensive materials such as zirconium must be used. Cost of power depends not only on fuel element cost but its life in the reactor as well. Long fuel element life involves problems of reactivity, corrosion, and radiation damage resistance.

Experiments Take Time

Although progress is being made, there are still many difficulties in obtaining either sufficiently cheap fuel elements for many reactors or adequate life. Fuel element life experiments by their very nature take extended periods of time and are complicated further by the present shortage of irradiation facilities and facilities for testing the irradiated elements.

It may be possible to discard fuel elements using a low degree of enrichment or natural uranium without any chemical processing if they are cheap to manufacture and have a very long useful life in a reactor. However, all other fuel elements and fuel materials must be processed to recover the unburned fuel, to recover the plutonium or U-233 made, and to reject and dispose of the fission products and other waste materials from the fuel elements. Markets for radioactive waste materials may develop. If they do, they will help pay for the processing cost.

Cost of chemical processing is related both to the amount of material processed and to its content of fuels and fission products. Thus longer fuel element lives will decrease the processing costs but not in direct proportion because part of the costs will depend on recovering and disposing of the radioactive materials. These are more nearly proportional to the power produced.

Processing Big Cost Factor

Unfortunately the fuel element designers and chemical processors are working at cross purposes in many cases. The result is that many fuel elements being considered today are difficult if not virtually impossible to process. In any case, chemical processing costs today are one of the limiting factors for economical nuclear power and development.

One beauty of homogeneous reactors is their avoidance of the fuel element fabrication problem and the

simplification of the chemical processing problem. However, it should by no means be considered that the homogeneous reactors do not have difficult chemical processing and waste disposal problems.

The costs of operating and maintaining the nuclear power plant must also be considered. These may well be higher than for conventional plants at least at the start but should not always remain higher.

Operation Will Be Costly

The only way in which operating costs can be determined with any degree of accuracy is by building and operating plants. This together with continuing research and development will ultimately reduce operating costs. In addition, the cost of a plant once built cannot be reduced, but the operating costs can be reduced as time goes on with substantial effects on the overall economics. Initial operating costs may be quite high for some reactors, but reductions of 50 or even 75% may be obtained within a few years bringing the operating costs well within the competitive range.

It is much more difficult to estimate operating costs today than even the construction costs. Even in the best cases they are certainly higher than the operating costs of conventional plants with all except the most expensive fuels. In the worst cases they may be several times conventional plant operating costs. The development of cheaper fuel elements, longer lived fuel elements, and cheaper chemical processing will correct this situation.

Reactor of the Future

The nature of the reactor of the future is difficult to predict. But the goals this reactor will have to meet are not difficult to predict. They include: higher operating temperatures, high specific power and minimum overall inventory, high conversion ratio, low enrichment fuel, minimum fabrication and fuel processing, and simplicity of design and operation. Perhaps non-aqueous homogeneous reactors of some sort will approach these goals.

Each individual reactor concept has its advantages and disadvantages. It is clear that there is no such thing as a perfect reactor concept and all types compromise to greater or lesser extent with the most desirable result. It is difficult to predict which reactor type will prove to be better than others. However, it seems evident that no one concept will ever be the best from all points of view and that, in fact, there will always be reasons for utilizing several different types of nuclear power reactor plants at the same time.

For example, one concept may prove useful for very large reactors, another for medium size reactors, and still a third for small power reactors. One concept may have some advantages but be of such a nature that it must be built in a remote location while another concept may be suitable for construction in heavily populated areas. In any nuclear power industry there will probably be a balance established by fuel economics among burners, converters, and breeders. The same type of relationship may develop between uranium and thorium reactors with one concept more useful for one and a different one for the other.

Still other factors may lead to use of other concepts; for instance, some reactors may be economic if located near a chemical processing center while other concepts may be better if the irradiated fuel must be shipped a great distance or processed in a small plant integral with the nuclear power reactor.

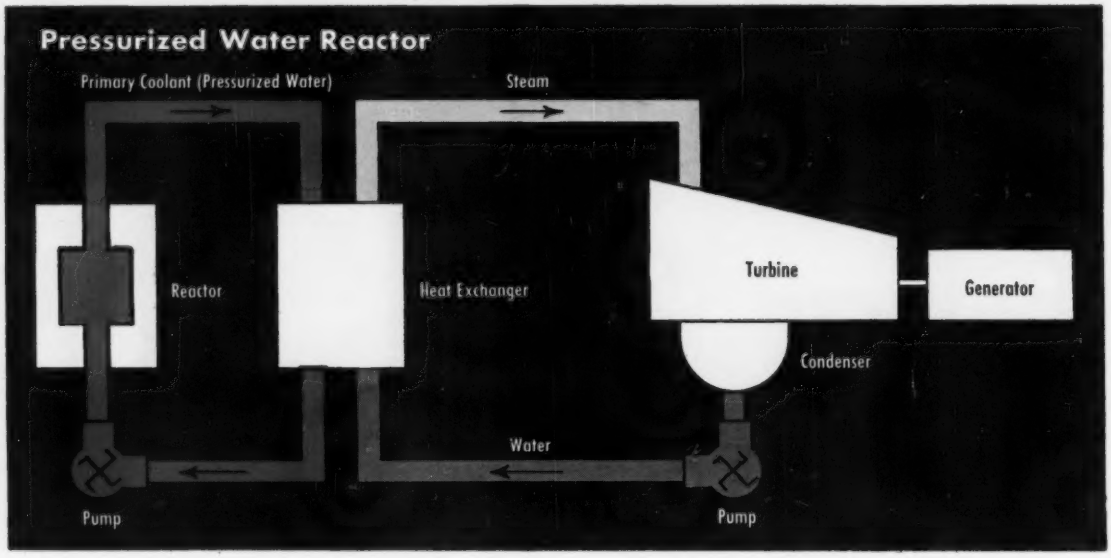
Better Reactors in Future

It seems a reasonable conclusion that there will be a need for several different types of power reactors and that while there may be a best type for a specific application there is no "perfect reactor." However, we believe that there are "better" reactors than those now conceived and that these will eventually be developed.

EXPERIENCE will be gained in joint industry-AEC projects such as the Shippingport Nuclear Power Plant shown in construction stages at right. Viewing the project from left to right are J. V. Willis, British Embassy; A. Tommaro and L. D. Geiger, AEC; C. H. Weaver, Vice Pres, Westinghouse Electric Corp; Admiral H. C. Rickover, AEC; Lewis L. Strauss, Chairman of the AEC; Sir Edwin Plowden, Chairman of the United Kingdom Atomic Energy Authority; P. A. Fleger, Chairman of the Board, Duquesne Light Co; and W. Grady, Project Mgr, Shippingport.

Variety Key to Cheaper A-Power

- Power plants using eight different reactor types will be built by utility industry and AEC in order to advance the art of nuclear power
- Advantages and disadvantages revealed by experiments or contemplated by design studies will be ascertained in full scale power plants



Pressurized Water Reactor

In this design a recirculating high-pressure water coolant system removes heat generated in reactor core. Coolant then transfers heat to a secondary system by means of a heat exchanger. Steam produced in secondary side of this heat exchanger then drives a turbine as in present day conventional thermal plants.

Principal advantage of the pressurized water reactor seems to be a matter of timing rather than technology. More research and development work has been accomplished on this type than on the others. In fact one power propulsion plant of this type is already in operation (submarine Nautilus).

But for the long pull it does not seem to be as promising as the others. Its high-pressure low-temperature system puts it at a thermodynamic disadvantage. High pressure also makes it necessary to provide expensive pressurized vessels and piping. Turbine cannot be of conventional design because it must handle low-pressure, low-temperature, saturated steam.

Three groups will use power reactors of this type. They are: **Duquesne Light Co and AEC . . .** AEC will design and construct reactor portion of plant. As indicated in the table on p 138, plant will be rated 60 Mw. And 835,000 lb of steam per hr at 585 psi will be delivered at turbine throttle. Low speed, 1,800-rpm turbine will be used. There will be four main coolant loops. Three of them must be operating to produce rated power (45,000-gpm flow). Nuclear portion of power plant will be housed in four steel plant containers.

Consolidated Edison Co of New York . . . This utility plans to improve the poor steam conditions of reactor by using a separately oil-fired superheater. By so doing, steam temperature will be raised from 450 to 1,000F. Capacity will be 236 Mw, 140 Mw from reactor and 96 Mw from superheater. Heat rate of combined reactor and superheater will be about 10,700 Btu per net kwhr.

Another feature of this reactor is that it will be a thorium converter (eg change fertile thorium to fissionable U-233 by means of the neutrons released in reactor core).

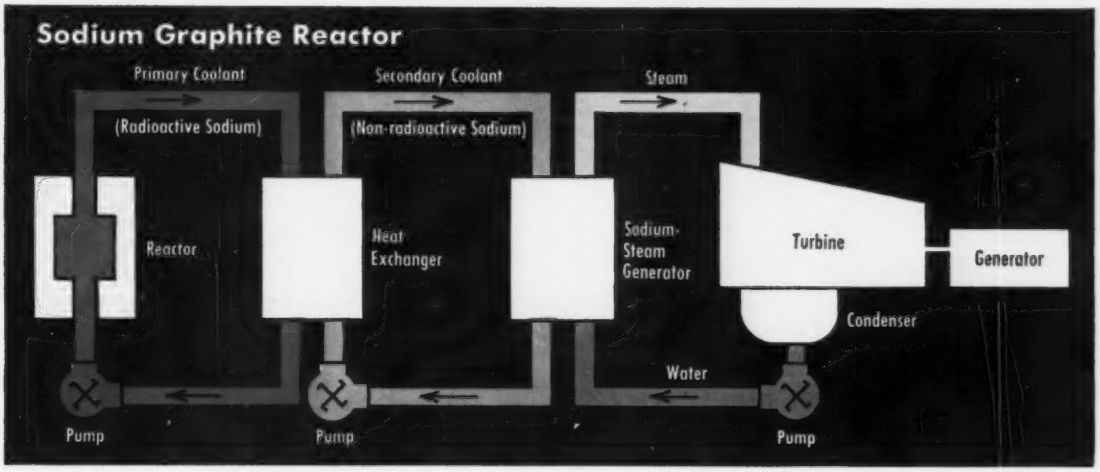
Yankee Atomic Electric Co . . . Modeled after the PWR being built at Shippingport for AEC. However there are differences in addition to the larger size. Yankee will use stainless steel instead of zirconium in the core, and enriched fuel will be uniform, not "spiked". Steam conditions of the two designs also differ.

There are at least 100 different possible reactor types. Fortunately the utility industry will not have to try each of these to obtain an economical one as some have already been eliminated by the AEC and its contractors. After studying this problem, the Commission in February 1954 concluded that five types showed promise and were sufficiently well advanced technologically to justify immediate or almost immediate experimental reactor construction. They were:

1. Pressurized water reactor.
2. Sodium-graphite reactor.
3. Boiling water reactor.
4. Fast breeder reactor.
5. Homogeneous reactor.

Recently AEC has shown interest in three additional reactor types: liquid-metal-fueled, gas cooled with gas turbine, and organic moderated. So that now there are eight major approaches to the search for economic power. As the art of reactor technology advances some of these may fall by the wayside as uneconomical and others may be proposed.

But at the present time the eight reactors listed above are now our approach to economical nuclear power. Following is a brief description of these types and information about some of the projects that will use these approaches.



Sodium Graphite Reactor

This reactor uses liquid sodium as a heat transfer fluid. Reactor core is cooled by a primary sodium loop. Heat from this loop is transferred to a secondary sodium loop in intermediate heat exchangers. Steam to drive the turbine is produced in steam generators with the secondary sodium supplying the heat. Graphite is used as the moderator (material which slows down neutrons and makes it more probable for them to cause fission and continue chain reaction).

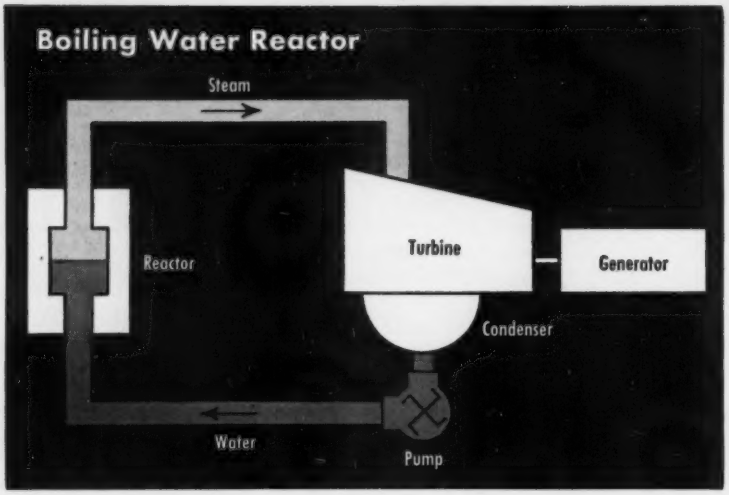
Use of sodium permits operation at high temperatures without pressurization thus overcoming one of the objections of PWR reactor. This of course permits good steam conditions and high thermal efficiencies. In addition sodium system presents no special corrosion problems if the oxide content in sodium is held sufficiently low as there are no chemical incompatibilities in fuel element, coolant, and structures. Cold trapping appears to offer a satisfactory technique for accomplishing this. It is necessary, however, to can the graphite moderator in zirconium to prevent absorption of sodium which would result in poor neutron economy (degree to which neutrons are used in desired ways instead of being lost).

Reactor can be adapted to a variety of fuel elements and operating conditions. Much of sodium research and development work has been done in connection with SIR (Submarine Intermediate Reactor) and EBR No. 1 (Experimental Breeder Reactor). Its fluid dynamics are similar to water.

On debit side of ledger is fact that sodium reacts violently with oxygen and water and must therefore be isolated from them. But this is not unusual to regular chemical manufacturing or processing practices. Further, neutron capture makes sodium a strong radioactive gamma emitter. For these reasons steam generator is separated from the primary loop, which extracts heat from reactor by the secondary sodium system which does not become radioactive. Second sodium loop and need for absolute leak tightness makes sodium circuitry expensive. Only one utility-size power reactor of this type has been proposed.

Consumers Public Power District, Columbus, Neb. . . . Steam conditions of this 75-Mw plant will be 800 psi and 825F. This is substantially better than the approximately 500F temperature maximum and 600 psi pressure maximum of PWR plants. Plant will have four primary sodium loops, two secondary sodium loops, and two steam generators. Sixteen pumps will provide pumping power, two in each of four primary loops and four in each of two secondary loops.

Further improvements in performance are expected in future plants. Development work is under way to raise steam conditions to 1,450 psi and 1,000F. Thorium will be used as fuel in this design.

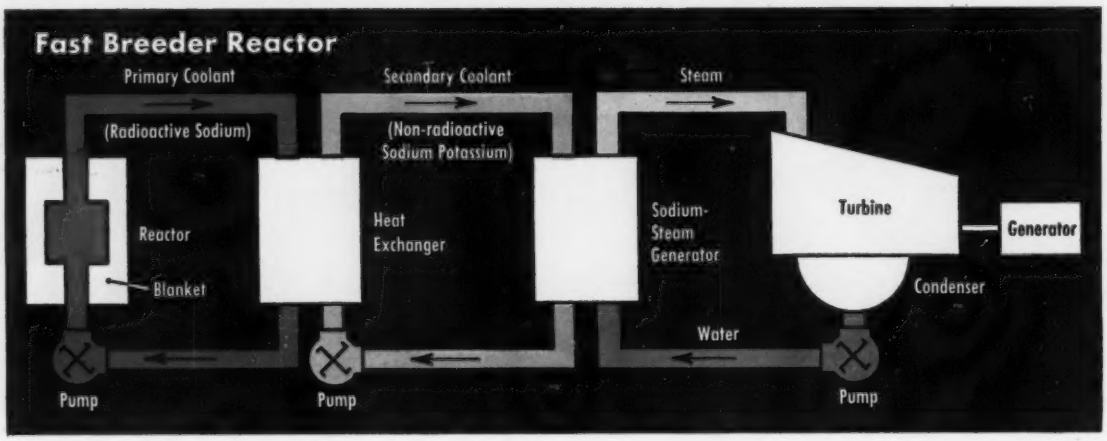


Boiling Water Reactor

Absence of a heat exchanger makes this reactor system similar to a conventional thermal station cycle—the major difference is the replacement of the boiler with a reactor. Heat from core causes water to boil and circulate through upper portions of reactor vessel, out through a steam drum, and hence to turbine.

When this reactor was first proposed, it was feared that it was not stable or safe. But in the now-famous Borax I tests conducted by AEC, stability was proved under extreme operation conditions, and certain inherent safety features were established.

The lower pressures of this system



Fast Breeder Reactor

This is the only reactor proposed that will use fast instead of slow or thermal neutrons (neutrons in thermal equilibrium with substance in which they exist; when neutrons are released in fission, they are called fast neutrons because of their high velocity and energy). Fuel is highly concentrated in this design, and therefore heat removal is one of the primary problems. A liquid-metal coolant, such as sodium, must be used to give high heat transfer rates. This presents the same problems of oxygen and water contamination and radioactivity that the sodium-graphite reactor presents. Reactor thus uses two sodium circuits.

Reactor can breed or make new fuel. This may become an economic advantage if cheap reprocessing methods can be developed. No moderator is required to slow the neutrons down to thermal levels. Less-stringent neutron economy requirements permit wide latitude in selection of materials. Steel, for example, can be used for structural and fuel cladding requirements. On the other hand, this design requires a large critical mass (amount needed to sustain a chain reaction). This means a large costly fuel inventory.

The breeder reactor that has been proposed may have a fuel inventory of three or four times as much fuel as is in the reactor. Tentative plans call for three months for fabrication, three months for cooling of the "hot" elements after they have been removed from the reactor, and three months for processing.

In addition there are severe safety system requirements because of the very short neutron lifetimes possible in fast reactors. And the nuclear characteristics in the fast region are less well known than in the thermal region. High heat transfer rates (rapid burnup of fuel) imposes the necessity for development of rapid and cheap fuel processing to minimize out of pile fuel inventory.

This approach has been suggested in the power field by Power Reactor Development Co, a utility group.

Power Reactor Development Co . . . Experts believe it has a real opportunity of becoming commercially justifiable. However as indicated by high capital cost, its technology is not so advanced as that of other types. High fuel and consequently heat concentration of this reactor can be realized from the fact that with a core size of about 2-½ ft in diameter and 2.5 ft high 300 Mw of heat will be produced. Instead of using sodium in the secondary loop this system will use NaK (Sodium potassium).

are the primary cost advantage. Capital costs are also reduced by elimination of heat exchangers. In some designs the reactor's pumping power requirements may be lower. Heat transfer coefficients are higher, but other factors may make heat transfer rates no higher than in PWR type.

Because of absence of heat exchanger possibility of significant radioactivity deposits in turbine, condenser, and feedwater pumps must be considered. If deposits are significant they may hamper operations, increase need for shielding, and will most certainly be a big factor in maintenance operations. All of these will of course add to expense of this type reactor.

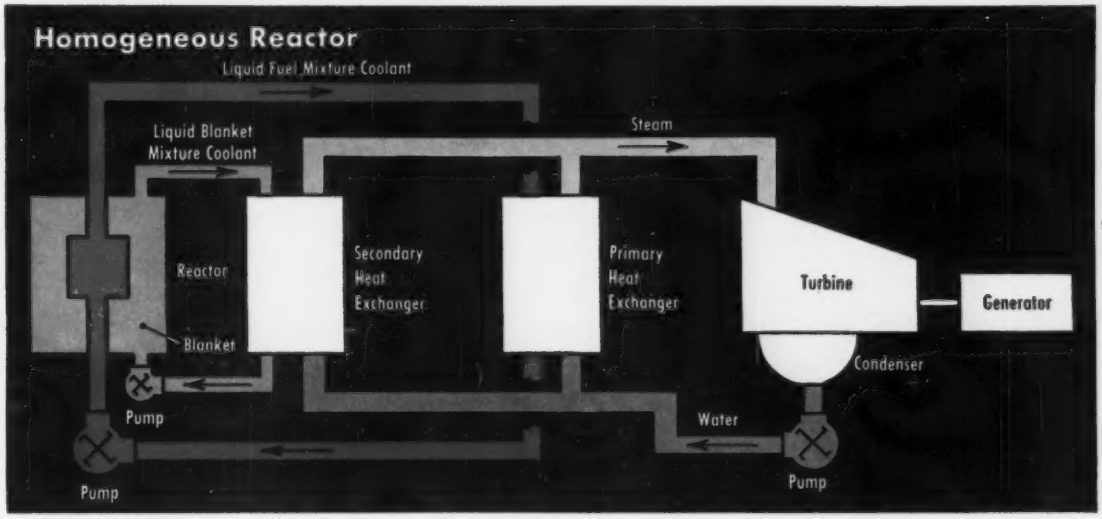
Although the reactor is quite safe and stable, controlling it may be more difficult. It has certain limitations in response to load demand changes.

Two boiling water reactors have been proposed. One by a group of utilities and another smaller one by a rural cooperative. It is significant that neither of these are what might be called a "conventional" boiling water reactor. Both have modified reactor to overcome some of disadvantages indicated above.

Nuclear Power Group . . . Dual-cycle reactor is name of reactor proposed by this group of utility companies. There are two cycles in this system, a boiling cycle and a flash cycle. Part of water boils in reactor vessel, and the water which does not evaporate in passing through the reactor is flashed to around 500 psi, thus making more steam available for introduction into turbine. Load fluctuations are handled by flash cycle.

Other details of this design are shown in the table on p 138.

Elk River Rural Cooperative Power Association . . . This reactor is modified by addition of a heat exchanger to prevent radioactive fluids from flowing in turbine or boiler-feed water circuits. It will also use a separately fired superheater, like the Con Ed reactor. Natural convection will produce circulation within reactor vessel.



Homogeneous Reactor

Designed to use fuel in liquid rather than solid state. The fuel, moderator, and coolant are one in the same medium. This mixture is pumped between reactor core and heat exchangers by means of connecting piping. In an aqueous homogeneous reactor the moderator and coolant are both water. The water can be either light or heavy water.

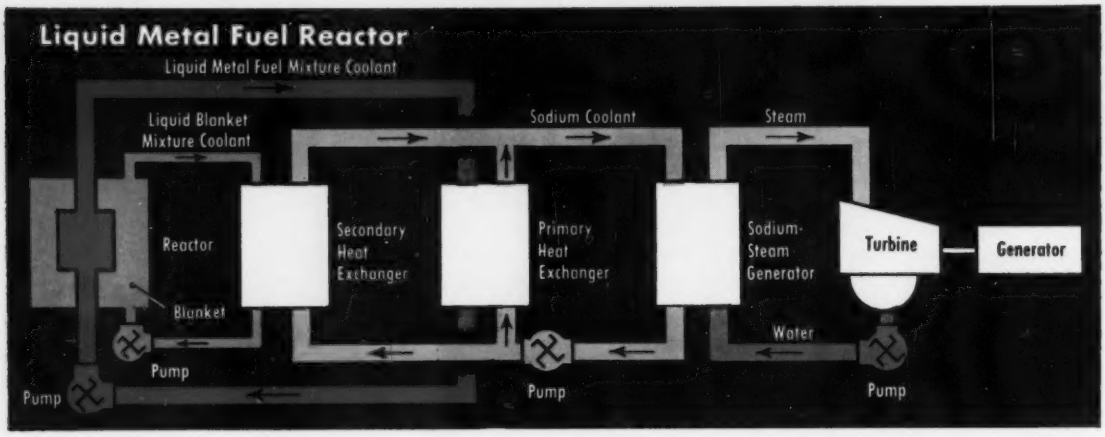
Components are so sized that only in the core does fuel attain critical size (accumulation of enough fuel to sustain a chain reaction). Steam is produced in secondary side of heat exchanger in a manner similar to other reactor systems. Fuel reprocessing can be carried out in a continuously operating system.

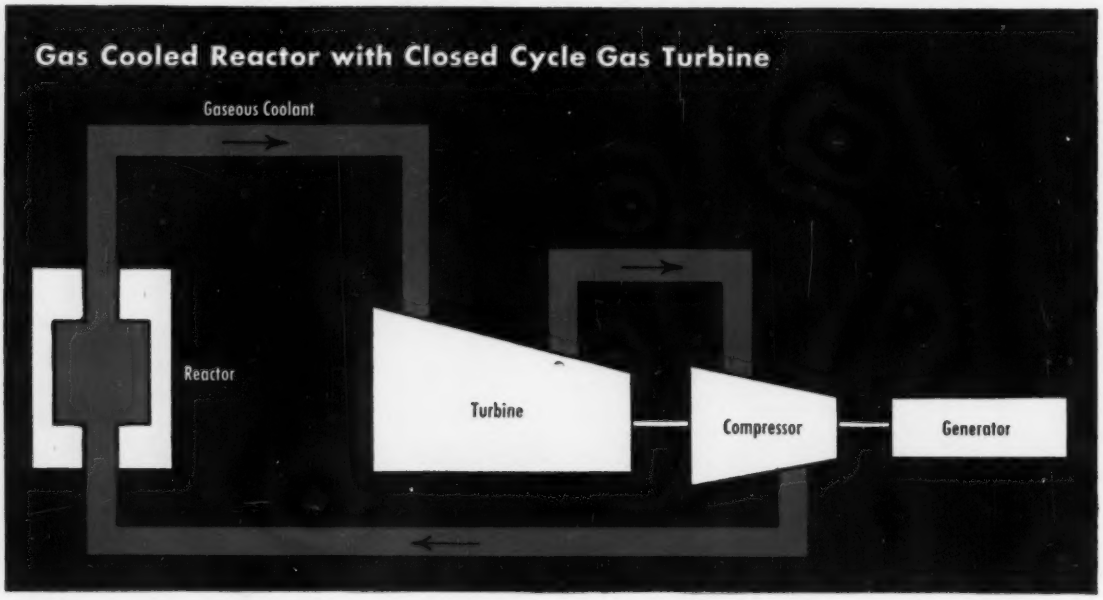
This reactor is attractive because of its basic simplicity. Fuel element fabrication and handling are eliminated. It is completely self-regulating and requires no mechanical control rods. Continuous removal of fission products appears feasible, this extends fuel life before complete reprocessing is necessary. The resulting higher neutron economy makes this type a good prospect for a thorium breeder type of reactor.

Another advantage is that reactor design can be based upon optimizing the nuclear parameters and not on the problem of removing heat. The rate at which heat is removed is dependent upon the rate at which the fuel is circulated through the reactor and its allowable temperature rise.

But the promise of economic operation is not without a few "ifs." Fuel solutions used are highly corrosive. In addition the system components are continuously subjected to radiation effects. Radiation may also have a detrimental effect on chemical stability of the fuel. This reactor is also subject to the same pressure and temperature limitations of the PWR thus efficiencies are lower. There are also difficulties in the development of slurries which appear to be required for thorium breeders or converters.

Utilities have proposed to build two homogenous reactor power plants—a large one, 150 Mw by Pennsylvania Power & Light Co, and a small one, 10 Mw by Wolverine Electric Cooperative. Only those details shown in the accompanying table on p 138 are available at this time.





Gas Cooled Reactor with Closed Cycle Gas Turbine

Use of a gaseous cooling medium presents a whole new series of reactor types. The heated gas can be used to produce steam (an example of which are the power reactors now under construction in England). Interest in this country however centers around use of this cycle in conjunction with a gas turbine.

Such cycles can be of the closed or open type, with or without heat exchangers.

Heat exchanger presents same advantages and disadvantages as its use did with other reactor systems. It increases capital costs, requires additional maintenance because of heat exchanger, pumps, piping etc, and decreases thermal efficiency. But it keeps turbine free or "hot" gas and corrosion products from reactor and permits use of different gases in reactor and turbine circuits.

Open-cycle unit without heat exchanger is of course the simplest and cheapest plant to build provided its capacity is not too great. In larger sizes its space and volume requirements become excessive. However, closed-cycle gas-cooled reactor plant offers small space and volume requirements with excellent efficiency.

Reactor must operate at temperatures high enough to supply turbine with 1,200-1,500F gas. This means fuel-canning material must withstand temperatures higher than those considered necessary for other reactor designs. But if certain thermal-stress and shock problems can be solved, ceramics may be the solution.

Air, carbon dioxide, nitrogen, and helium have been suggested as possible working media. Like all gases they have disadvantage of small volumetric heat capacity. Air presents additional corrosive problems, but helium will not react with metals at temperatures likely to be encountered. Nitrogen likewise is inert to most reactor materials. It would however produce more radioactive products than helium.

One closed-cycle gas turbine plan was submitted by the City of Holyoke, Mass., in second round of AEC Power Demonstration Program.

◂Liquid Metal Fuel Reactor

Reactor is basically same as homogeneous type. Both use fuel in a liquid form. Major difference is fuel solution—homogeneous uses uranyl sulfate while liquid metal fueled reactor proposed by Brookhaven National Labaratory uses a solution of uranium in bismuth.

Another difference is the fact that the LMFR uses a solid graphite moderator. This reactor has a breeder blanket (portion of reactor containing fertile material that can be transformed into fuel). A slurry of thorium bismuth in bismuth is used to remove heat from this section of reactor.

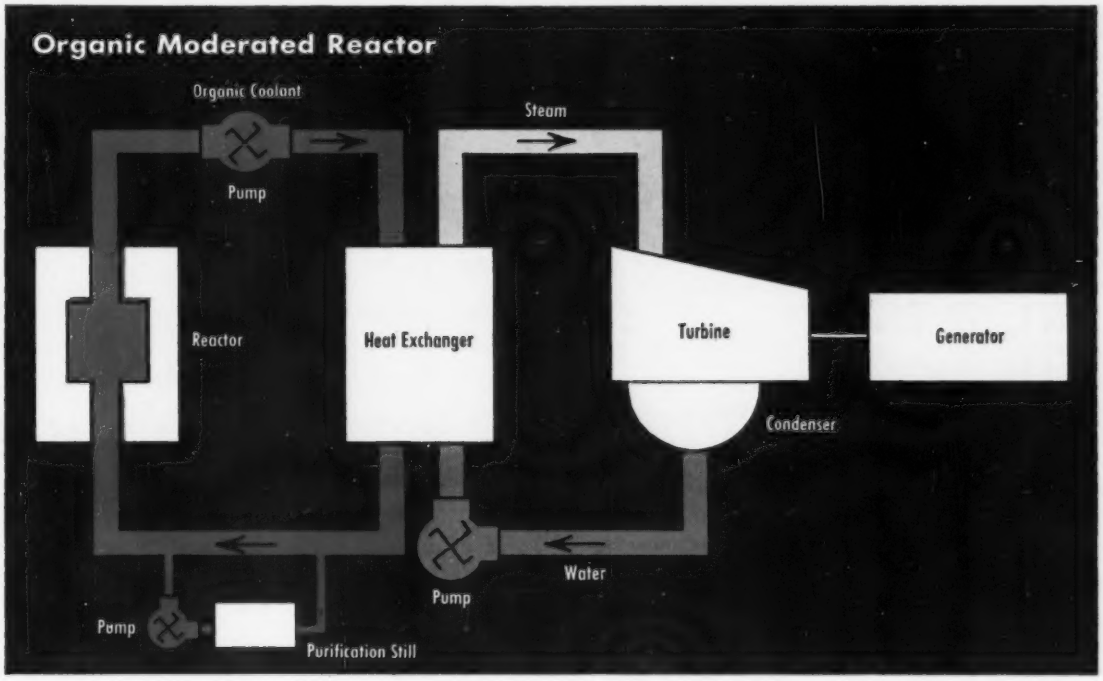
Heat in reactor core and blanket fluids is transferred in heat exchangers to a sodium loop. This heat produces steam in sodium-steam generators.

The absence of solid fuels is an advantage. It is controlled by varying uranium concentration in fuel solution so that complicated control rod systems are not required. There are low pressures throughout reactor, sufficient neutron economy for breeding, and a simple fuel handling system requiring only pumping. In addition a continuous fuel, blanket, and waste processing system can be integrated with reactor.

System, however, is not without disadvantages. Only laboratory scale experimental work has been performed on this concept to date. Highly specialized maintenance of radioactive fuel and blanket equipment is required. And rigid cleaning procedures and leak tightness are necessary to insure oxygen-free fuel and blanket systems. There is also the high cost of pumping and procurement of bismuth to consider.

One plant of this type, in the 25 to 40-Mw unit size, has been proposed by City of Orlando, Fla.

Available details on this plant are shown in the table on p 138.



Organic Moderated Reactor

Heat in the reactor core is absorbed by an organic material, such as the carbon-hydrogen compounds diphenyl or terphenyl. The hot liquid gives up its heat through heat exchangers. Electric power can be produced by using the conventional steam boiler and generator to convert the heat to electricity. A still purifies the diphenyl for re-use in the reactor system where it serves as both a coolant and a moderator to sustain the atomic fission process. The principal interest lies in application to small reactors.

Use of diphenyl offers advantages which stem from the inherent properties of the material: **1.** It has a high hydrogen content which makes it an excellent moderator. **2.** It boils at relatively high temperatures compared with water so there is no need to maintain the compound under high pressures. **3.** It causes negligible corrosion with standard materials of construction. **4.** It does not react readily with uranium. **5.** It becomes only slightly radioactive upon exposure to nuclear radiation.

This reactor system also has the advantages of compactness (similar to the water moderated and cooled reactors).

Problems to be solved are concerned chiefly with the effect of heat and radiation on the organic coolant. They tend to cause the liquid to deteriorate, with consequent loss of material, gas problems, and the possibility of fouling of the fuel elements and heat exchanger surfaces.

One plant of this type has been proposed by the Municipal Power Dept of Piqua, Ohio. This proposal is contingent upon the success of the Organic Moderated Reactor Experiment which is scheduled for completion late this year at the Atomic Energy Commission's National Reactor Testing Station.

Proposed A-Power Plants

Roundup shows that 15 plants have been proposed. Total capability will be about 1,000 Mw. Actual construction and equipment costs will approach $300 million. All plants will probably be operating within the next six years

Company	Consolidated Edison Co	Commonwealth Edison Co and Nuclear Power Group, Inc[4]
Location	Indian Point, N. Y.	Dresden (near Chicago)
Type of financing	Privately financed	Privately financed[5]
Reactor type	Pressurized water	Boiling water
Reactor manufacturer	Babcock & Wilcox Co	General Electric Co
Reactor thermal power, Mw	500	625
Station gross generating capacity, Mw	236[3]	180
Estimated cost of reactor, millions of dollars		34.2
Estimated cost of turbo-gen plant, millions of dollars		10.8
Total estimated plant cost, millions of dollars	55	45.0
Total estimated plant cost, dollars per kw	230	250
Estimated cost of energy at busbar, mills per kwhr	9	
Estimated operating date	1959	1960
Moderator	Light water	Light water
Coolant	Light water	Light water
Reactor temp, degrees F[2]	500	545
Reactor press, psi	1,500	1,000
Steam temp, degrees F	1,000[3]	545
Steam press, psi	370	1,000
Steam flow, lb per hr	1,900,000	
Fuel, enrichment, % U-235	90%. Thorium used as fertile material	1.1%

[1] Not including research and development, fabrication of fuel for first charge, or nuclear materials unless noted otherwise. Fuel element fabrication and nuclear materials are included in fuel costs.

[2] Average temperature of coolant in reactor unless noted otherwise.

[3] Will use separately fired superheater to raise steam temperature from 450 to 1,000F. Superheater will provide 96 Mw of capacity, reactor 140 Mw.

[4] Members of Nuclear Power Group, Inc are:
American Gas & Electric Co
Central Illinois Light Co
Commonwealth Edison Co
Illinois Power Co
Kansas City Power & Light Co
Pacific Gas & Electric Co
Union Electric Co
Bechtel Corp

[5] Commonwealth Edison will pay $30 million (charged to plant account). Remaining $15 million will be supplied over period of five years by Nuclear Power Group, Inc.

[6] Members of Yankee Atomic Electric Co are:
Boston Edison Co*
Central Maine Power Co
Central Vermont Public Service Corp
Connecticut Power Co
Connecticut Light & Power Co*
Eastern Utilities Associates
Hartford Electric Light Co*
New England Electric System
New England Gas & Electric Association*
Public Service Co of New Hampshire
Western Massachusetts Electric Co
Jackson & Moreland

Pennsylvania Power & Light Co	Yankee Atomic Electric Co[4]	Duquesne Light Co	Detroit Edison Co. and others[5]	Consumers Public Power District, Columbus, Nebr.
PP&L service area	Rowe, Mass.	Shippingport, Pa.	Detroit Edison service area	Columbus, Nebr.
Privately financed	AEC Power Demonstration Program[7]	AEC 5-Yr Reactor Development Program[8]	AEC Power Demonstration Program	AEC Power Demonstration Program
Homogeneous	Pressurized water	Pressurized water	Fast breeder	Sodium graphite
Westinghouse Electric Corp.	Westinghouse Electric Corp.	Westinghouse Electric Corp.	Power Reactor Development Co.	North American Aviation, Inc.
	480	236	300	250
150	134	60 (100 ultimate)	100	75
	17.4	27.7	36.0	13.5
	16.0	10.0	9.0	10.8
	33.4	37.7	45.0	24.3
	246	370		320
				10-11
1962	1960	1957	1959	1958-59
	Light water	Light water	None	Graphite
Fuel solution	Light water	Light water	Sodium	Sodium
	535	540	800 (outlet)	925
	2,000	2,000	100-200	10
	486	Saturated	730	825
600	600	585	600	800
		835,000 (at 60 Mw)	1,000,000	
Uranium in liquid form	2.7%	90% in seed. Natural uranium in blanket	20%	1.8%

* Also participating individually in the research development activity of APDA.

[7] AEC will:
a. Waive charges for loan of source and special nuclear material for fuel for a period of seven years.
b. Offer use of AEC laboratories for research and development work without cost.
c. Support research and development work in non-Commission facilities in return for the research and development information.

[8] Under this program government intends to construct five preferred types of reactors, primarily with government financing.

[9] Other companies joining Detroit Edison are:
Alabama Power Co
Central Hudson Gas & Elec Corp
Cincinnati Gas & Electric Co
Columbus & Southern Ohio Electric Co
Consumer Power Co
Delaware Power & Light Co
Georgia Power Co
Gulf Power Co
Iowa-Illinois Gas & Electric Co
Long Island Lighting Co
Mississippi Power Co
Philadelphia Electric Co
Potomac Electric Power Co
Rochester Gas & Electric Co
The Southern Co
Toledo Edison Co
Wisconsin Electric Power Co
Allis-Chalmers Manufacturing Co
Babcock & Wilcox Co
Burroughs Corp
Combustion Engineering Corp
Holley Carburetor Co
Westinghouse Electric Corp

Company	Orlando Utilities Commission	Elk River Rural Cooperative Power Assoc	Municipal Power Dept
Location	Orlando, Fla.	Elk River, Minn.	Piqua, Ohio
Type of financing	AEC Power Demonstration Program[3]	AEC Power Demonstration Program	AEC Power Demonstration Program
Reactor type	Liquid metal fueled	Boiling water	Organic moderated
Reactor manufacturer		AMF Atomics, Inc	North American Aviation, Inc
Reactor thermal power, Mw		58	45.5
Station gross generating capacity, Mw	25-40	22[4]	12.5
Estimated cost of reactor, millions of dollars[1]	12.5	3.76	3.34
Estimated cost of turbo-gen plant, millions of dollars	8.0	2.43	1.96
Total estimated plant cost, millions of dollars	20.5	5.19	5.30
Total estimated plant cost, dollars per kw	512-820	281	424
Estimated cost of energy at busbar, mills per kwhr		6.49	
Estimated operating date	1960-61	1960	1960
Moderator	Graphite	Light water	Hydrocarbon
Coolant	Liquid bismuth for primary loop	Light water	Hydrocarbon
Reactor temp, degrees F[2]	1,000	535 (outlet)	617
Reactor press, psi	Sealing and dynamic pressures only	900	30
Steam temp, degrees F	900-950	825[4]	550
Steam press, psi	1,250	615	410
Steam flow, lb per hr	250,000-400,000	225,000	
Fuel, enrichment, % U-235	Highly enriched uranium as U-Bi solution. Thorium in Bi as fertile material	Fully enriched uranium spikes. Natural uranium core	3%

[1] Not including research and development, fabrication of fuel for first charge, or nuclear materials unless noted otherwise. Fuel element fabrication and nuclear materials are included in fuel costs.

[2] Average temperature of coolant in reactor unless noted otherwise.

[3] AEC will:
a. Waive charges for loan of source and special nuclear material for fuel for a period of seven years.
b. Offer use of AEC laboratories for research and development work without cost.
c. Support research and development work in non-Commission facilities in return for the research and development information.

Municipal Gas & Electric Dept	Chugach Electric Assoc	Wolverine Electric Cooperative	Southern California Edison and North American Aviation, Inc	Pacific Gas & Electric Co and General Electric Co
Holyoke, Mass.	Anchorage, Alaska	Hersey, Mich.	Santa Susana, Calif.	San Francisco Bay area
AEC Power Demonstration Program	AEC Power Demonstration Program	AEC Power Demonstration Program	AEC 5-Yr Development Program for reactor[7]. Turbo-gen privately financed	Privately financed
Gas cooled with closed cycle gas turbine	Sodium cooled	Homogeneous	Sodium graphite	Boiling water
Ford Instrument Co	Nuclear Development Corp of America	Foster Wheeler Corp	North American Aviation, Inc	General Electric Co
44	40	31	20	
15	10	10[4]	7.5	5
2.4	5.50	2.48	5.3[8]	
4.0	1.85	1.08		
6.4	7.35	3.56		3-4
429	735	356		
		7.18-9.43		
1960-61	1961	1959	1957	1957
Graphite	Heavy water	Uranyl sulfate in heavy water	Graphite	Light water
Nitrogen	Sodium	Heavy water	Sodium	Light water
1,292 (outlet)[5]	950	570	960 (outlet)	545
510[5]	Atmospheric	2,000	300	1,000
	850	825[6]	825	545
	850	600	600	1,000
1,080,000		116,000		82,000 (to turb) 165,000 (reactor max)
3%	2%	Enriched uranium	2.9%	Enriched uranium oxide

[4] Will use separately fired superheater to raise steam temperature from 450 to 825F. Superheater will provide 5 Mw of capacity, reactor 20 Mw.

[5] No steam in cycle, nitrogen coolant flows through reactor and turbine.

[6] Will use separately fired superheater to raise steam temperature from 450 to 825F.

[7] Under this program government intends to construct five preferred types of reactors, primarily with government financing.

[8] Includes building to house reactor and fabrication of fuel elements for first charge but not fissionable materials.

How Much Will Atomic Power Cost?

- The energy costs for large atomic power plants range from 7 to 11 mills per kwhr depending on size, reactor, and type of fuel burned
- Pressurized water reactor power plants appear to be economically attractive when conventional fuel costs over 60¢ per million Btu

DONALD KALLMAN, Nuclear Economist, Babcock & Wilcox Co, New York, N. Y.

Despite the fact that full-scale nuclear power plants are not yet operating, it is possible to give the range of costs for these plants. One reason for this is that several manufacturers are now able to offer fixed-price proposals for certain full-size nuclear power plants. This is important because the initial investment in a nuclear plant accounts for the largest portion of the cost of nuclear power.

In general, manufacturers can offer fixed-price proposals for heterogeneous thermal reactors of the pressurized-water and other types which utilize solid fuel elements containing thorium and uranium of various enrichments.

This article discusses the cost components of larger nuclear power plants in the 50 to 300-Mw range. Energy costs for typical large nuclear plants appear to lie in the range from 7 to 11 mills per kwhr. These costs will depend upon the size of the reactor, as can be seen in graph at right. The type of nuclear fuel used, slightly enriched or highly enriched, etc., also has a bearing on overall costs.

Just a few years ago, the conceptual design studies indicated plant investment costs of $400 to $800 per kw. In recent years the fullscale development efforts on pressurized-water reactors which have led to the prototype Submarine Thermal Reactor, to the U.S.S. Nautilus, and to the Shippingport power plant have removed many of the unknowns from this PWR reactor system.

Equipment manufacturers which have fabricated reactor vessels, heat exchangers, pressurizer tanks, controls, and instrumentation for these projects have learned that the costs of fabricating these major components are predictable as fabrication is in accordance with customary techniques for stainless steel equipment.

As manufacturers have developed confidence in their ability to predict the cost of the heavy steel equipment components, much uncalled for mystery has been removed from the cost of the nuclear steam generating plant. This has resulted in a substantial lowering of quotations for pressurized-water reactor equipment. Some of this confidence has affected quotations for other heterogeneous thermal reactor types.

Using recent fixed price quotations for PWR reactor plants and providing an appropriate budget for the conventional power plant equipment, it would appear that equipment for a 130-Mw nuclear power plant, if contracted for in the next few years would

Breakdown of Nuclear Power Costs

	130-Mw All-Nuclear Plant (mills/kwhr)	130-Mw Fossil Fuel Plant (mills/kwhr)
Fixed charges	4.7	2.7
Nuclear fuel	2.6	...
Conventional fuel	...	4.6
Nuclear fuel inventory charges	0.5	...
Operation and maintenance	0.8	0.6
Energy cost	8.6	7.9

A summary of the various energy cost components is shown in tabulation above. These figures for the nuclear plant are based upon our present state of knowledge of a pressurized-water heterogeneous thermal converter reactor power plant. They assume continuation of the present fissionable material values. Certain financing expenses are not included. The following assumptions are also made:

1. Annual fixed charged of 13%.
2. Load factor of 80%.
3. Conventional fuel cost of 40¢ per million Btu burned with an 86% efficiency.
4. AEC nuclear inventory charges of 4% per yr.

The predicted energy costs for larger and smaller nuclear plants, based upon the same assumptions, are at the right together with typical plant investment costs for conventionally fueled plants.

These plant investment costs for conventionally fueled plants were taken from the Electrical World's Ninth Steam Station Cost Survey. They are combined with typical operating and maintenance costs and heat rates to show the energy costs for various conventional fuel costs from 20¢ to 60¢ per million Btu. This figure shows that, based upon the many assumptions used, conventionally fueled plants appear to be economically more attractive today than nuclear fuel plants of the pressurized-water type where conventional fuels cost less than 40¢ per million Btu. On the other hand, where conventional fuels cost more than 60¢ per million Btu, pressurized-water reactor power plants would appear to be economically attractive. In the intermediate range between 40¢ and 60¢ per million Btu. nuclear plants offer promise in the larger sizes.

cost about $33 million ($255 per kw) installed. This is the estimated investment cost for a complete pressurized-water reactor system with all associated power plant equipment located on a minimum site in a rural area with a mild climate.

For estimating purposes, the site and its improvements are included to the extent of a nominal $10 per kw, only. Many sites for early nuclear power plants may be large, and the site improvements may be foresightedly designed for a number of adjacent nuclear steam generators. Included is the cost of a critical assembly and some miscellaneous research and development work. This does not, however, include the cost of fabricating the first fuel element loading. Field construction expenses and shipping costs are estimated for a plant constructed in a medium-cost area of the United States.

To this estimate should be added contingency and any capitalized financing charges during construction and testing, the cost of working capital for the initial and replacement nuclear fuel loadings, for other fuel and operating expenses, and some provision for cost escalation.

Comparable investment costs for nuclear power plants of greater or lesser capacities are shown in Fig 1. Above 130 to 150 Mw two or more separate pressurized-water reactors may be used because reactor pressure vessel walls are limited to about 8-in. thickness today.

Under certain circumstances the use of an oil, coal, or gas-fired superheater may be attractive. The investment costs for such a nuclear power plant may be somewhat less than an all-nuclear plant.

Plant investment costs for other reactor types may, when they are more fully developed, be comparable to the cost of pressurized-water reactor systems. Some of the advanced reactor concepts will have higher thermal cycle efficiencies and thus will require less heat removal capcity in the reactor primary system. The decrease in the cost of heat exchangers and primary system piping may, however, be counterbalanced by more expensive construction materials and devices, and in the case of some liquid metal reactors, the cost of a secondary coolant circulating loop.

Fuel Costs Depend on AEC

Nuclear fuel costs are not as predictable as plant investment costs. The costs and credits for fissionable materials and the costs for the reprocessing of spent fuel are tied, at least temporarily, to U. S. Atomic Energy Commission policies and cost accounting. These values can be foreseen with assurance for only the earliest years of nuclear plant operation.

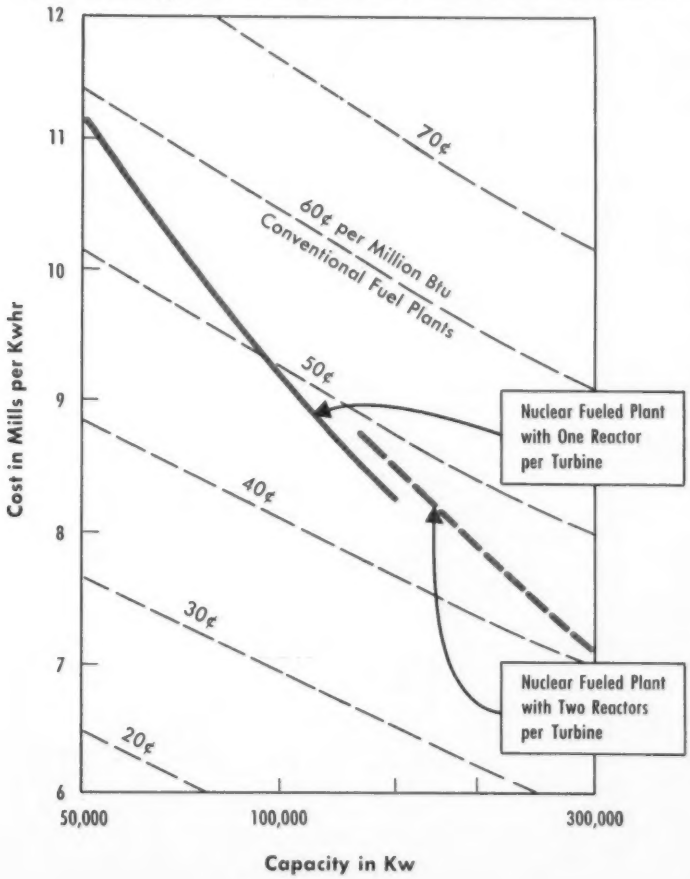
Fortunately, some costs, such as for fuel element fabrication, which are high today because of undeveloped techniques and expensive materials, should decrease in later operating years. Thus, in estimating nuclear fuel costs, it is well to consider both immediate and long-range costs.

Fissionable material costs, valid until 1962, may be ascertained from the AEC Confidential Price List which has been made available to Access Permit holders. We can only assume that there will be no major change in these fissionable material values so long as they are under AEC control. However, these values might rise or fall considerably in a free market.

The approximate net fissionable material cost for a large, well-designed, heterogeneous, thermal converter reactor appears to lie between 5 to 10¢ per million Btu. This includes the cost of U-235 consumed, less the credit for byproduct plutonium or U-233 based upon present values. The cost estimate applies to any of these three fuel arrangements: **1.** slightly enriched uranium, **2.** highly enriched uranium core (or seed) with natural-uranium blanket, **3.** highly enriched uranium core (or seed) with thorium blanket.

These three different fuel arrangements can yield similar net fission-

Typical Energy Costs for Nuclear & Conventional Power Plants



able material costs in heterogeneous, thermal converter reactors. U-235 which may be burned out of slightly enriched uranium must be paid for at a high value, and the plutonium recovered is credited at a different, generally lower, value. For the core-and-blanket reactor part of the heat will come from expensive U-235 of high enrichment and part of the heat will come from the inexpensive U-235 in the natural uranium. The plutonium is credited at an intermediate value.

For the thorium reactor the premium value of byproduct U-233 pays for the larger fraction of the heat that must come from the highly enriched uranium. In general, the core-and-blanket fuel arrangements may have a slightly lesser net fissionable material costs than the slightly enriched uranium fuels.

Fabrication and reprocessing costs and the freight charges for spent fuel element coffins can be estimated roughly, based upon certain assumptions as to fractional U-235 burnup and/or irradiation level. The fabrication, reprocessing, and freight costs for highly enriched core (seed) elements will depend upon the fraction of U-235 which can be burned out of these fuel elements before they must be removed from the reactor. As can be seen in Fig 2, which shows some typical costs, these expenses may decrease from 29¢ per million Btu for a 50% burnup, to 18¢ per million Btu for an 80% burnup.

For slightly enriched uranium fuels or for blanket elements of natural-uranium or thorium, the fabrication, reprocessing, and freight costs vary inversely with the irradiation level, in terms of MW-days of heat released per ton of uranium or thorium. These costs for slightly enriched uranium or for blanket elements may decrease from 29¢ per million Btu at 4,000 MWD/ton to 6¢ per million Btu at 20,000 MWD/ton. (Fig 3).

For slightly enriched uranium, it is reasonable to assume that the fabrication, reprocessing, and freight costs will lie between 10 and 15¢ per million Btu during 20 years of nuclear plant operation. This takes into account probable advances in technology and cost reduction. Fuel costs for slightly enriched uranium might be as follows: Net fissionable material cost—5 to 10¢ per million Btu, and fabrication, reprocessing, and freight —10 to 15¢ per million Btu for a total of 20¢ per million Btu.

FIG 1 — Investment Costs for Nuclear Power Plants

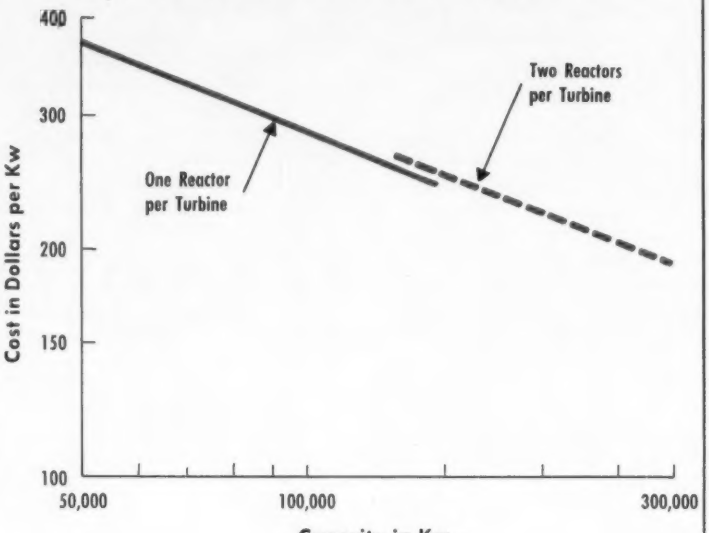


FIG 2 — Typical Fuel Cost for Fabrication, Reprocessing & Freight
(Highly Enriched Uranium)

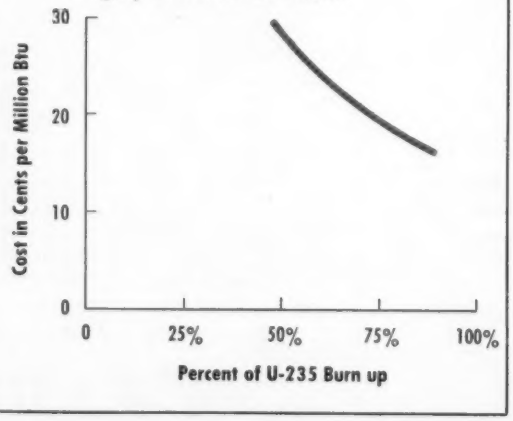
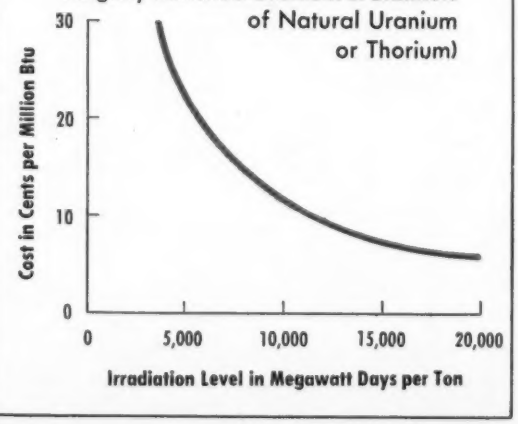


FIG 3 — Typical Fuel Cost for Fabrication, Reprocessing & Freight
(Slightly Enriched Uranium & Blankets of Natural Uranium or Thorium)



For core-and-blanket fuel arrangements part of the heat is withdrawn from highly enriched uranium elements. Typical fabrication, reprocessing, and freight cost for this portion of the heat are shown in Fig 2 to be slightly higher than the fabrication, reprocessing, and freight cost for the blanket heat portion as shown in Fig. 3. However, the core-and-blanket fuel arrangements may have some advantages over the slightly enriched uranium loading, such as less inventory, greater byproduct fissionable material production, and the opportunity to manufacture either Pu or U-233. Thus the net nuclear fuel costs for the core-and-blanket arrangements appear to be similar to the slightly enriched uranium fuel costs. For the example on the first page long-range nuclear fuel costs of 20¢ per million Btu for a typical fuel arrangement have been assumed.

Inventory Is Minor Cost Item

Although nuclear fuel inventory charges may be of great significance for small reactor plants and mobile reactors, for large central station power plants with heterogeneous thermal reactors the inventory costs appear to be a minor cost item. A study of several recent pressurized-water reactor designs shows that the nuclear fuel inventory costs may be about 0.5 mills per kwhr. This estimate is based upon present fissionable material values. A liberal allowance has been included for fissionable material in the processes of fabrication, fission product decay cooling, and reprocessing. This cost may vary between 0.3 and 0.7 mills per kwhr, depending upon whether zirconium or stainless steel-clad fuel elements are used.

For a number of reasons the inventory is partially related to the heat output, so this estimated cost range is approximately applicable to the entire power range of 50 to 300 Mw.

Operating labor and maintenance costs for a number of new conventional power plants were presented in Electrical World's Ninth Steam Station Cost Survey, Oct. 17, 1955. Representative operating and maintenance costs taken from this survey are shown in Fig. 4.

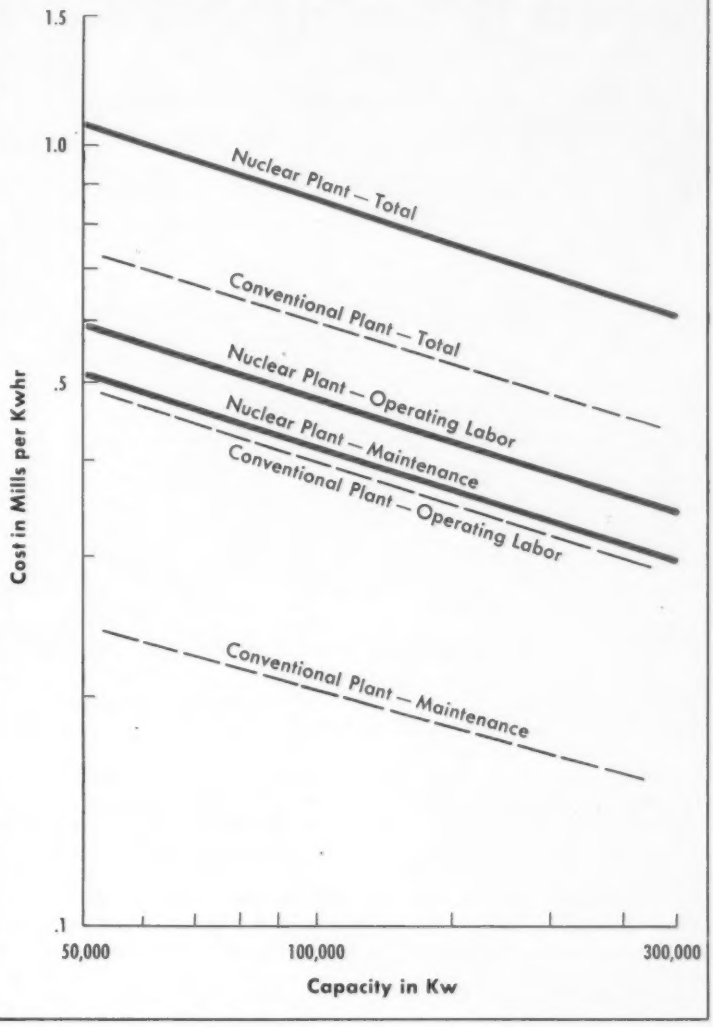
Because most of the reactor portion of a nuclear power plant must be uninhabited during routine plant operation, it is not possible to inspect or adjust this equipment continuously. The equipment components will be designed and selected for reliable operation without such continuous inspection. The few shift operators will, therefore, be mostly in the control room. However, the uniqueness of the nuclear plant may call for additional technical personnel on the day shift. Thus operating labor for a 150-Mw nuclear power plant might be 20% higher than for a conventional plant, or 0.42 mills per kwhr.

Maintenance and repair costs will not be predictable with accuracy until after several years of nuclear power reactor operation have been achieved. But an estimate is needed today.

The investment cost for a nuclear power plant is expected to be about 50% greater than for a conventional power plant. In addition, annual maintenance and repair costs may prove to be a higher percentage of the plant investment, at least for the reactor portion. For these reasons maintenance and repair costs for a 150-Mw nuclear plant of the pressurized-water type might be double the costs for a conventional plant.

Operating and maintenance costs for a typical 150-Mw kw nuclear power plant might, therefore, be estimated at 0.42 mills per kwhr for operating labor, plus 0.36 mills per kwhr for maintenance and repairs, or a total of approximately 0.8 mills per kwhr. Estimated costs for larger or smaller plants are shown on Fig 4.

FIG 4 — Operating and Maintenance Costs



Evaluation of available information indicates that . . .

Fusion Is Not Practical Process

- It does not pose a threat to fission process as a power source because of the high temperature and containment problem
- Satisfactory solution of fusion problem probably requires the discovery of a new "idea" and then a long period of development work

S. B. RANDOLPH, Industrial Analyst, Nuclear Development Corp of America, White Plains, New York

Solution of problems involved in the fusion process is, in all probability, a long term project. If a solution is possible, it would involve some new "idea" which has not yet been conceived. When and if the necessary basic idea is produced, many years of experimental and technical development would be required to produce a satisfactory commercial apparatus.

This paper attempts to outline what is involved in a fusion reaction, why it might be considered advantageous, what materials could be involved as fuels, some of the basic difficulties and disadvantages, and the necessity for finding some new "idea" instead of extending existing methods and technologies.

It can be experimentally observed, by measuring the masses, that the nuclei of elements about halfway between the lightest and heaviest are, from the nuclear standpoint, the most stable. One effect of this is that the fusing (joining) of light element nuclei or the fissioning (splitting) of heavy element nuclei to form new nuclei results in the release of energy. This released energy is, in effect, that required to hold the nuclear mass in a form other than its most stable form. Because of certain physical principles, however, energy is required to initiate the fusing process.

In general, the fusion of two light nuclei will provide net energy return when the resulting product has an atomic weight below about 40. If this net return is in the proper form and can be properly utilized to initiate further fusion, a chain reaction can be maintained and excess energy may be available in the form of heat.

A fusion reactor would be a device which would utilize nuclear fusion reactions to provide a net output of usable energy. "Controlled" and "uncontrolled" refer, in general, to the rate of energy release, the criterion for "controlled" being usability without self-destruction of the device.

To cause the fusion of two light nuclei they must be brought into contact with each other. All nuclei contain protons (positively charged particles) and are positively charged. The electrical fields of two nuclei are therefore mutually repulsive and tend to keep the nuclei from getting near each other. In order for contact to be made, this electrical repulsion must be overcome. The repulsive effect is proportional to the size of the charge. This, in turn, depends on the number of protons present. It follows that the lighter the element, the smaller the charge and the easier the bringing together of the nuclei.

To overcome the electrical charge repulsive effect, one must give the nuclei high velocities. The necessary velocities correspond thermally to temperatures in millions of degrees. This means that if a light element were heated to many million degrees, some of the atoms would be moving with velocity great enough to permit collision between two nuclei heading directly for each other; contact and fusion of the two nuclei could result.

Temperature Controls Rate

It should be remembered that the velocity corresponding to the thermal energy at any given temperature is the **average** velocity of the particles. There will always be some particles moving faster and some moving slower. The effect of this is that there does not exist a fixed temperature above which a reaction will go and below which it will not. Instead, the effect of the temperature is to control the rate.

At a lower temperature relatively fewer nuclei will possess a sufficient velocity to achieve fusion. As the temperature increases, more and more of the nuclei have sufficient velocity; and the reaction rate (or energy release per unit mass in a given time) increases.

Present day methods in physics permit us to give, by ways other than heating, very high velocities to atomic particles including nuclei of the very light elements. These velocities, easily attained with modern accelerators, correspond to the thermal velocities which permit fusion.

Here's How Fusion Stands Today

1. Announced studies to date have not shown controlled fusion to be impossible.
2. The practical problems requiring solution are enormous.
3. A new idea for solution will probably be required.
4. Should an idea be found, considerable time would probably be needed to develop a device.
5. There are no indications of success in finding a solution.
6. If a device is developed, it might use any of a number of possible light elements as fuel.

There is an important difference, however, between energy that a heated material has by virtue of its temperature and energy of nuclei accelerated by other means. So far, this discussion has not considered some very important atomic particles—orbital electrons. These do not take a **direct** part in fusion reactions because the fusion is of nuclei.

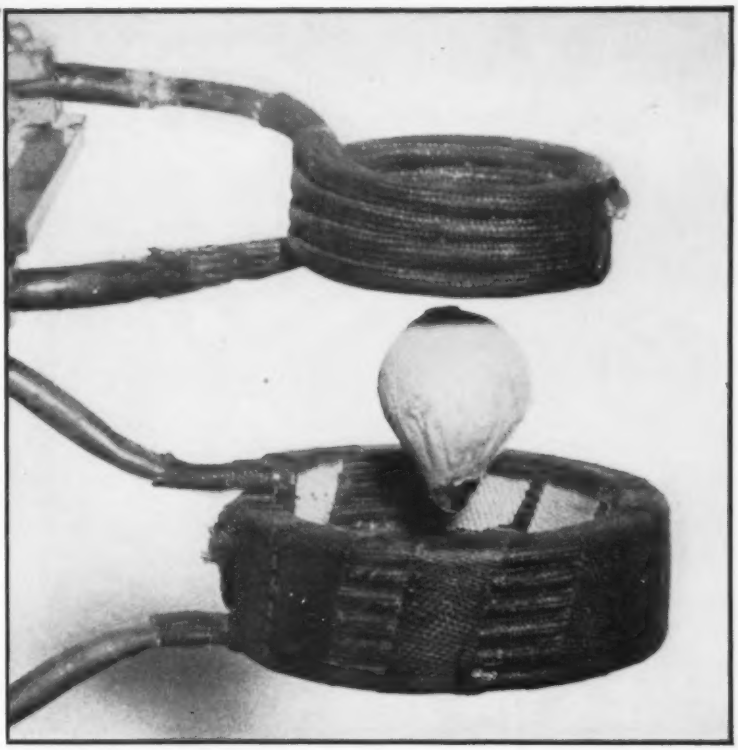
Each nucleus in its normal state, is surrounded by a number of electrons equal in number and charge to the protons in the nucleus. When we heat a material, thermal energy gives velocity to the whole atom so that the electrons as well as the nuclei have, on the average, the thermal energy. Even if, at very high temperatures, the electrons become dissociated from their respective nuclei they will have the thermal energy. If we consider an incoming charged particle, some probability exists for an interaction causing energy transfer with electrons and some for interaction causing fusion. The ratio of probabilities greatly favors the electron energy transfer.

Use of Accelerator Improbable

Consider two average atomic nuclei in a very hot mass moving at high velocity in directions so that their paths converge. Their orbital electrons have similar high velocities. Before the nuclei meet, however, the high probability exists that they will have to travel through the fields of the orbital electrons of a great many other atoms whose nuclei they will miss because the nuclei are so much smaller than the electron fields.

Because all the electrons have, on the average, the same energy of motion as the nuclei we are considering, the probable **net energy transfer** between the nuclei and the interfering electron fields will be zero; and the kinetic (velocity) energy of the two meeting nuclei will be available to overcome each nuclei's repulsive force.

If we now direct the nuclei, in a stream, at high velocity into a mass of some light element not at high temperature, the orbital electrons of the material in the cold mass are not at high energy (velocity). The incoming particle loses on the average so much energy to the interfering fields of the electrons that it has insufficient energy to overcome the repulsive field of the nucleus for which it is heading. These facts preclude the use of a particle accelerator for impinging light nuclei on a low temperature mass and achieving fusion at any rate sufficient to provide a net energy return.



CONTAINMENT PROBLEM caused by the extremely high temperatures of the fusion reaction may be solved by suspending the reacting materials in an electromagnetic field similar to the method used in the metallurgical experiment above

Although atoms have been fused in laboratory devices, the energy input has always greatly exceeded the energy output because of losses of the type mentioned above.

In conventional accelerators the particle beams are relatively narrow and confined. The particle motion is orderly and in one general direction. This means that although the particle velocity might be sufficient to cause fusion if it were to meet another nucleus, the relative velocity between nuclei in the beam is, in general, below that required for fusion. Even if two such beams were crossed, the volume that they shared could not, with present devices, be made large enough to offer a reasonable chance for fusion-producing collisions to offset the misses.

We have mentioned that sufficiently high particle velocities are obtained to cause fusion when the material is at a temperature of many millions of degrees. It is extremely difficult to obtain and hold such temperatures. They exist in the sun because the sun's mass is so vast it is unable to radiate energy to space fast enough to allow the interior, where the energy is created, to cool. They exist in a fission bomb explosion where a vast amount of energy is released in an extremely short period of time.

The difficulty in having materials exist at these temperatures under more controlled conditions is that they tend to heat the surroundings so much that they vaporize their containers. In a controlled fusion reaction it is, therefore, necessary to contain the high velocity particles by means other than conventional containers. One possibility for the containment might lie in the use of intense electromagnetic fields because the particles are charged. (Charged particles moving in magnetic fields feel forces which might be used to contain them.)

One of the problems in accelerator design lies in preventing the loss of beam particles through collision with the walls of the apparatus. Recent advances have been made in high energy accelerator work in which new techniques in shaping magnetic fields are

Possible Fusion Reactions

1. $D + D \rightarrow He^3 + n + 4.0$ mev
2. $D + D \rightarrow T + H + 3.3$ mev
3. $D + T \rightarrow He^4 + n + 17.6$ mev
4. $Li^6 + D \rightarrow Be^7 + n + 3.4$ mev
5. $Li^6 + D \rightarrow He^4 + He^3 + n + 1.8$ mev
6. $Li^6 + D \rightarrow He^4 + He^4 + 22.4$ mev
7. $Li^6 + D \rightarrow T + Li^5 + .75$ mev
8. $Li^6 + n \rightarrow T + He^4 + 4.8$ mev
9. $Li^7 + n \rightarrow Li^8 + 2$ mev

Last term shows energy per reaction in million electron volts.

employed to retain beams of particles more efficiently.

While present high energy machines are not directly suitable for the production of power from fusion, some of the ideas and techniques may be helpful.

Electromagnetic containment has the possible advantage, at least in principle, of permitting the extraction of some of the energy directly as electrical power when the charged particles do work against the applied field.

The possibility also exists that a mass of light element material might be temporarily heated by shock waves, electrical discharge, or similar means. This might raise the temperature high enough to yield sufficient fusion energy to repeat the initiation process with a useful excess. This (little burst) method would have the additional advantage of permitting heat transfer to the surroundings at a more easily controlled rate.

If solutions are found to the very difficult high temperature initiation and containment problems outlined above, it might be possible to construct a device to produce power from the fusion process at controllable rates. Some discussion of the advantages and disadvantages of such a process, assuming its feasibility, is therefore, warranted.

Several possible fusion reactions are listed in the table. These involve as fusing particles the nuclei of: deuterium (D) which is "heavy" hydrogen, tritium (T) which is "super-heavy" hydrogen, Li^6, and Li^7 which are the two isotopes of the third lightest element, lithium. Reactions involving heavier materials like beryllium and boron are conceivably useful, but their nuclear electrical charge is higher. This gives an increased repulsive effect which contributes to the difficulty of causing contact. Reactions (8) and (9) fuse a nucleus with a neutron.

Deuterium, whose nucleus (D) figures in most of the reactions, is present in natural water in the ratio of about 1 atom to every 7,000 atoms of the normal hydrogen isotope. The important meaning of this is that all of the world's water contains a basic fuel for the fusion process, and dependence on regional fuel resources is eliminated.

Tritium does not occur in nature in recoverable amounts. Li^6, which comprises about 7% of natural lithium (the other 93% being Li^7) is limited in availability to the geographical sources of natural lithium. It must be isotopically separated.

Reactions (2), (7), and (8) produce In addition to energy, a T which might, in turn, be caused to react as in equation (3) to produce further energy. Also, several of these reactions produce neutrons which we know are capable of releasing energy by fissioning uranium or partaking in reactions like (8) and (9). This would, of course, introduce the disadvantages of a fission reaction, notably highly radioactive fission products. It has been speculated that the largest part of the energy of the "hydrogen bomb" comes from just such a combination of fusion and fission reactions.

The direct products of fusion reactions are considerably less radioactive than the products of fission reactions. During operation of a fusion reactor, however, radiation of high intensity might be expected. Reactions (1) and (2) which in a mass of D would occur together at about the same rate, give roughly one 3-mev neutron for about 7 mev of total energy released. Reaction (3) would give one 14-mev neutron for each 17-mev total. In fission reactions, on the other hand, there is about 5 mev of neutron energy (distributed among about 2.5 neutrons) for around 200-mev of energy released.

We can see, therefore, that for a given power or energy release we must shield against much more neutron energy in fusion reactions in which neutrons are released than in fission reactions. These released neutrons also present problems of nuclear activation of shield and structural materials.

In his news conference of Oct. 3, 1955, AEC Chairman Strauss indicated that the present research on thermonuclear reactions does not involve fission and that deuterium reactions like (1) and (2) are favored. He did not exclude the possibility that the other light elements might turn out to be useful.

Considering D-D reactions, it is interesting to note we can make one pound of heavy water for an energy expenditure of around 5,000 kwhr. If all the deuterium nuclei in this pound of water could be made to undergo fusion as in reaction (1) and (2), about 2,000,000 kwhr of energy would be released. If the T produced in reaction (2) could be utilized, considerable additional energy could be obtained. In all probability this would not all be useable electrical energy. For example, with present fission reactor systems we are able to convert about 20% of the energy released in fission to electricity.

Cost Can't Be Estimated

At the present time, when no detailed ideas, plans, or methods are proposed, it is impossible to define specific disadvantages of a fusion system. As outlined above, there may be question of shielding, fission products (if fission is included in a cycle), initiation of the reaction, temperature containment, and others.

Of course, it must be realized we do not know how to produce a controlled fusion process yielding net energy. Without knowing what the "unknown" successful technique would be, it is also impossible to discuss operating or capital costs in any except the most general terms. It seems likely that the containment and high temperature problems would demand, at least at first, a very large and expensive power plant.

Utility Men Optimistic About Atom

- Insurance looms high as problem, but industry is confident of an eventual solution. Cost is uncertain because of lack of experience
- Fuel expense is the biggest uncertainty; there is promise of a reduction. Fabrication and reprocessing costs are key to economics

A. S. Griswold Says . . .

"Accurate Cost Information Will Not Be Known for Four Years"

It's not possible to talk with any real intelligence about the economics of nuclear power plants until we know what the costs are, until we have built reactors that work and know the capital investment and operating costs. It will be at least four years before the industry has enough different kinds of reactors built and tested to provide any substantial information on this subject. We also think that it may take five years of operation before we'll know whether the gadgets built into these first power reactors are workable or if they are even necessary.

The fuel cycle is the key to economically competitive atomic power. Eventually capital investment costs can be reduced after we get more experience, but we don't think the cost of building a nuclear power plant will ever be substantially less than the cost of a conventional steam plant. After all, the reactor is only part of the plant.

This leaves nuclear fuel as the key to cost savings. First is the matter of the fuel cycle of various types of reactors. Then, too, fuel fabrication and reprocessing and use of by-products are two areas where costs may be reduced. And in this early stage of development there are still thousands of possible fuel alloys and cycles that might be used. Nobody knows yet which will be THE fuel.

Detroit Edison Co is a member of Power Reactor Development Company which plans to build a large breeder reactor. Initially that reactor may require a fuel inventory of three or four times as much fuel as is in the reactor to handle the fuel element fabrication and reprocessing. We are thinking in terms of three months for fabrication, three months in the reactor, three months for the cooling of the "hot" fuel elements after they have been removed from the reactor, and three months for processing.

Disposal of radioactive waste may be a big and, perhaps, expensive problem. While industry has been very anxious to undertake atomic power production, there has been a tendency to let the government be concerned with waste disposal matters. These two positions are contradictory. Something will have to be worked out, and as yet, there doesn't seem to be an answer.

We do not anticipate any regulatory problems. Detroit Edison has made a special effort to keep the Michigan Public Service Commission informed of the scientific, technical, engineering, and management aspects of the project. The chairman of the Michigan Public Service Commission has a security clearance, thus making it possible for us to keep him fully informed.

Arthur S. Griswold, Assistant to the President, Detroit Edison Co.

R. L. Schacht Says . . .

"Insurance Problem May Delay Atomic Power Plant Construction"

In my opinion, until the matter of insurance is solved, it is questionable that none-federal organizations can proceed with construction plans. Consumers Public Power District may face this insurance problem sooner than others proposing atomic power plants because the technology of our sodium graphite reactor is more fully developed than some of the other concepts. We might be one of the first to build.

The insurance industry has a difficult problem before it; nevertheless, both adequate protection and reasonable rates must be assured before proceeding with major equipment commitments on our part.

How about the future? It is doubtful that there will be any one year which will be designated as the time nuclear power has become competitive with other methods of producing electric power. The yardstick will vary from one locality to another and will vary from time to time. Three major fields seem to hold promise.

1. Fuel cost reduction through the improvement of fuel element life, lower fabrication costs, and lower chemical processing costs.

2. Operation and maintenance cost reduction.

3. Construction cost reduction through the inherent advantages of building several plants of one basic design, the elimination of over-design and the materials improvement needed to achieve better overall plant performance. For instance where two pumps are being specified today, perhaps the designer can specify only one after the industry gets some operating experience under its belt.

R. L. Schacht, General Manager, Consumers Public Power District, Lincoln, Neb.

J. F. Fairman Says . . .

"Our Progress Is Satisfactory; Future Prospects Look Good"

We are satisfied with the progress made to date on our Indian Point nuclear steam electric generating station. Its future prospects are good. We expect to be generating electricity from nuclear energy at Indian Point some time in 1960.

Present calculations indicate this power will cost about nine mills per kwhr at the station bus. Improvements in core design, which we may or may not have achieved by the time the station goes on the line, could reduce this figure. Standardization of fuel elements would also help reduce costs.

But it is still too early in the atomic industry for standardization. The electric industry is going to learn about atomic fuel by a many-sided approach to the problems. Remember we are still experimenting with alloys for high-pressure, high-temperature steam piping for use in conventional plants.

Indian Point, with its separate oil-fired superheater, has a very conservative reactor design. We fully expect to be able to incorporate into the reactor many advances in the pressurized water reactor concept.

When we figured the obsolescence rate of Indian Point, we had this flexibility feature in mind. We assigned the reactor portion of the plant the same life expectancy as the conventional portion of the plant. Conventional boilers built many years ago are still in use as reserve and peaking units. Indian Point's first unit may very well serve a similar purpose in our system operation in the distant future.

James F. Fairman, Vice President, Consolidated Edison Co of N. Y.

William Webster Says . . .

"We'll Learn by Experience; Fuel Key to Cost Reduction"

Why did we go into the nuclear power business? And once we decided to, why did we select the PWR reactor? We went into this business because that is the only way to learn, and we want to learn.

Some day nuclear power will be a necessity. We can't expect it to be economical tomorrow if we don't get started with it today. Of course we'll make mistakes like everyone else, but we will learn from them.

1960 is our target date for full operation of the plant, at least for the present. But we will delay operation if we discover that the delay will produce something that is a contribution to the art . . . something worth waiting for. . Philosophy behind Yankee Electric is to have all member companies share the power produced by our nuclear plant. That's one of the reasons why it will be located at Rowe, Mass. Here it can easily be tied into the transmission system that spans New England.

Why pick the PWR? Because its the reactor we know the most about. And its the one whose cost we can most accurately estimate. The PWR will probably be the workhorse for the next 10 or 20 years. Its design is flexible enough to take advantage of fuel technology improvements, and that is where we think improvements will come.

But our design will also make contributions to the art. If we are going to get ahead in this business, there is no sense in building a duplicate of what other people have proposed. Can't learn that way. So we're going to do a few things different in the PWR. For instance, we'll use stainless steel instead of zirconium to clad the fuel elements.

William Webster, President, Yankee Atomic Electric Co.

R. D. Maxson Says . . .

"Fuel May Be a Credit if Processing Costs Are Reduced"

We have contracted with General Electric Co to build a 180-Mw nuclear station at a cost of $45 million. One-third of this contract price, or $15 million, is being paid as a research and development expense by Nuclear Power Group, Inc. (American Gas & Electric Service Corp, Bechtel Corp, Central Illinois Light Co, Commonwealth Edison Co, Kansas City Power & Light Co, Illinois Power Co, Pacific Gas & Electric Co, and the Union Electric Co.)

The remaining $30 million plus the cost of the site and overheads, will be paid for and capitalized by Commonwealth Edison Co, which will own and operate the plant.

Based on 60% capacity factor, the cost of power to the Edison Co can be broken down as follows:

Fuel	2 mills
Other Operating and Maintenance Costs	1 mill
Carrying Charges	4½ mills

This adds up to 7½ mills per kwhr, about the same as the cost of energy from a modern conventional steam plant in our area. But this 7½-mill cost does not include any of the $15 million of research and development expense. If this were included the cost would be about 10 mills per kwhr.

We'll use only about 1% of the uranium energy in our fuel over a three year period. This suggests that a chemical processing of the used fuel elements might achieve very low fuel cost or even possibly a credit. The determining factor will be the cost of the chemical processing.

R. D. Maxson, Senior Vice President, Commonwealth Edison Co.

Indianapolis Power & Light meets area's growth with 100,000 kw addition to White River station

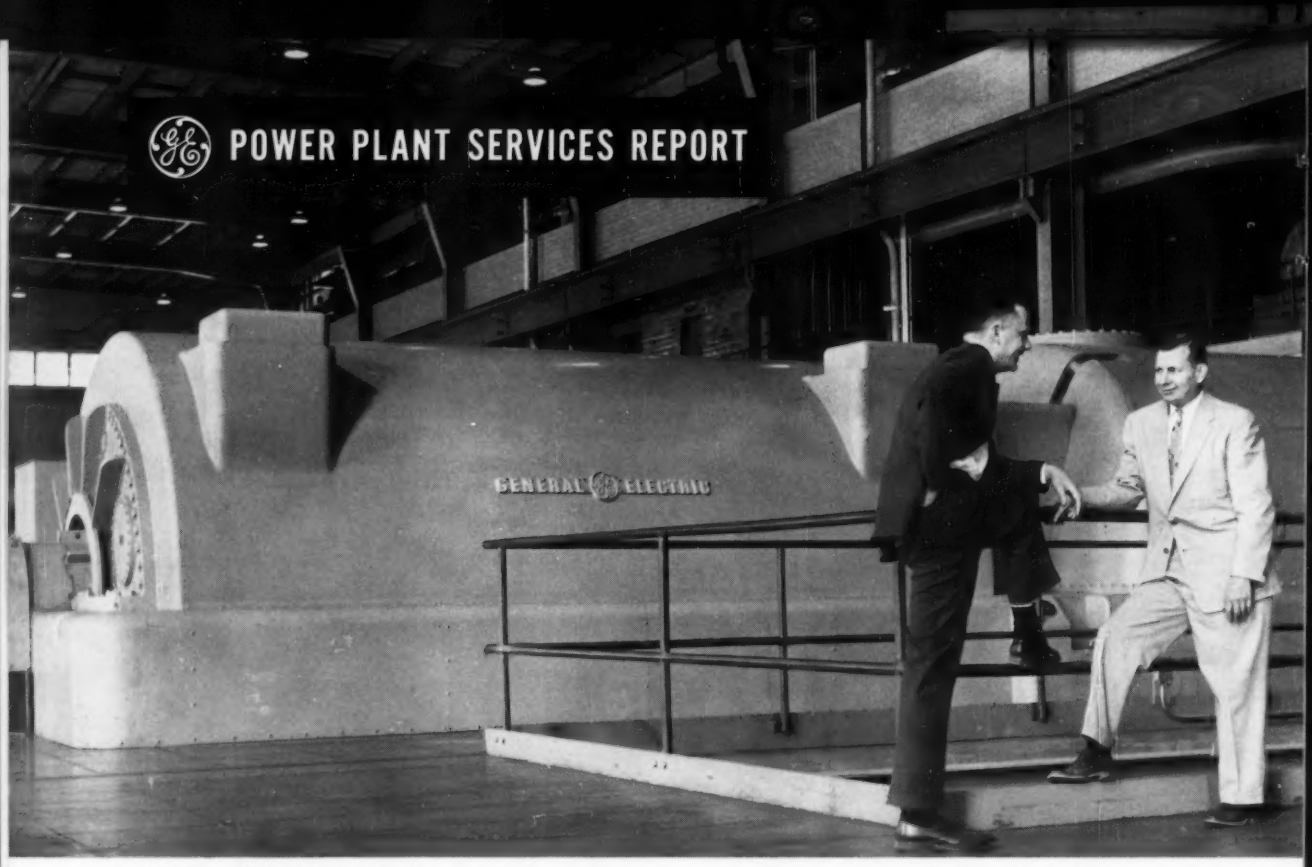
The enormous postwar industrial and residential boom in and around Indianapolis—load has soared to well over twice 1945's figure—meant this: Indianapolis Power & Light had to act fast to keep ahead of its customers' growing demands for electricity.

And act fast it did. More than $100,000,000 have been invested in system expansion since 1947—twice the amount spent during the previous 20 years. The high point of this growth is the White River station.

In expanding this plant by installation of a 100,000-kw G-E turbine-generator, IP&L is stepping up total system capacity about 20%. By specifying "General Electric," the utility and its consultants, Gibbs & Hill, Inc., were able to capitalize on General Electric power plant services . . . saving time, money and manpower.

FOR MORE DATA TURN PAGE ▶

GENERAL ELECTRIC

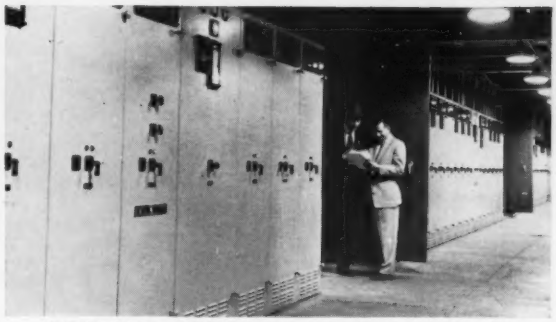


ADVANCE PLANNING, coupled with well-integrated plant and equipment design, helped Indianapolis Power & Light to achieve on-time start-up of new General Electric 100,000-kw turbine-generator at the White River station, latest addition to system.

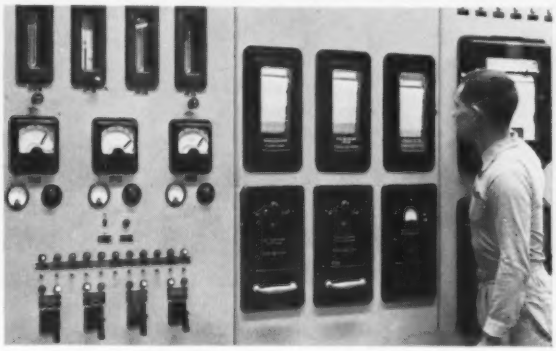
I. P. & L.'s sixth G-E unit at White River

REVIEW of proposed expansion of the White River station is made by D. C. Hess, V. P., Engineering and Construction; J. D. Blythe, Administrative Asst.; H. T. Pritchard, Pres.; all of IP&L, as John Calder, G-E sales engineer, looks on.

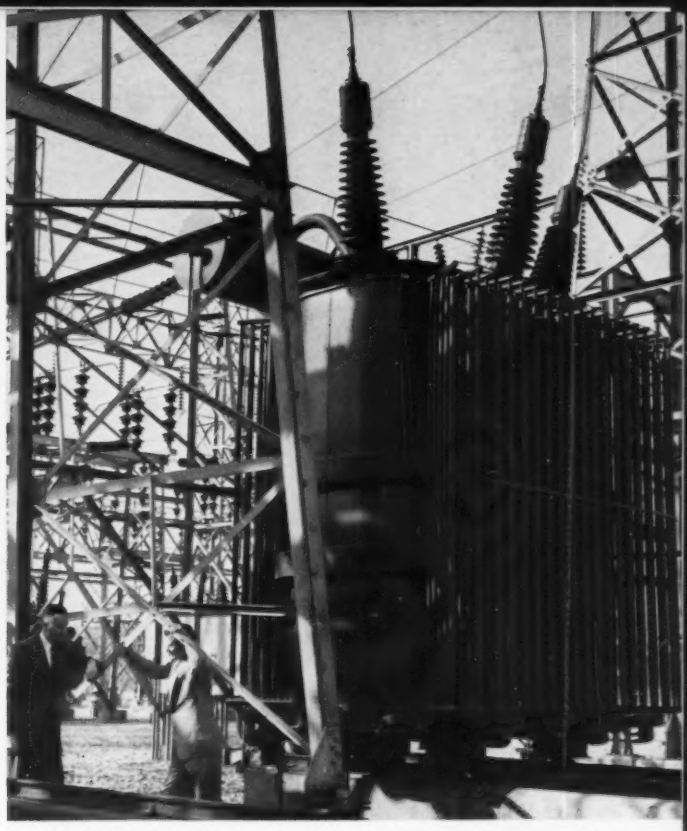
STATION'S IMPORTANT PHASES got full attention of E. L. Champion, Gibbs & Hill, Inc. V.P.; IP&L's Pritchard; D. B. Sloan, Gibbs & Hill, Inc., Pres.; and IP&L's D. C. Hess; G-E engineers freed utility, consultant of many details.



INTEGRATED DESIGN of General Electric metal-clad switchgear with other apparatus was assured by G-E application engineers to help give the White River station the advantages of top operating flexibility.



PROPER SELECTION of General Electric turbine-supervisory instruments is paying off for Indianapolis Power & Light in terms of more efficient operation and prolonged life of power generating equipment.



ON-TIME DELIVERY of equipment like the 3750-kva General Electric auxiliary power transformer shown here, assured by General Electric power station services, helped speed power plant construction, and helped reduce installation costs.

fills out co-ordinated expansion program

G-E teamwork with IP&L and Gibbs & Hill, Inc. engineers, assures integrated equipment designs, saves engineering time on White River plant expansion

Sound planning for the future has first priority in Indianapolis Power & Light's expansion program. For example, at the White River station where IP&L had previously installed five G-E turbine-generators, a sixth 100,000-kw unit was recently added to meet expanding load requirements. Each of these units has been carefully co-ordinated with associated electrical equipment in design and operation to assure maximum flexibility and effectiveness in plant operation.

G-E engineers, working with the utility and their consultants, Gibbs & Hill, Inc., co-ordinated the design and construction of the new apparatus to meet more exactly the station's operating requirements.

Such application engineering on new equipment is just one of many G-E power plant services on your job when you or your consultant order G-E apparatus. Product development engineering, field service engineering, and project co-ordination also help to:

Simplify ordering of equipment purchased either directly or through your consulting engineers, or through a machinery manufacturer.

Conserve engineering time by assisting with electrical equipment details, thereby freeing you and your consulting engineers for other urgent problems.

Integrate equipment design with consultant's plant design to assure the maximum flexibility and effectiveness of operation.

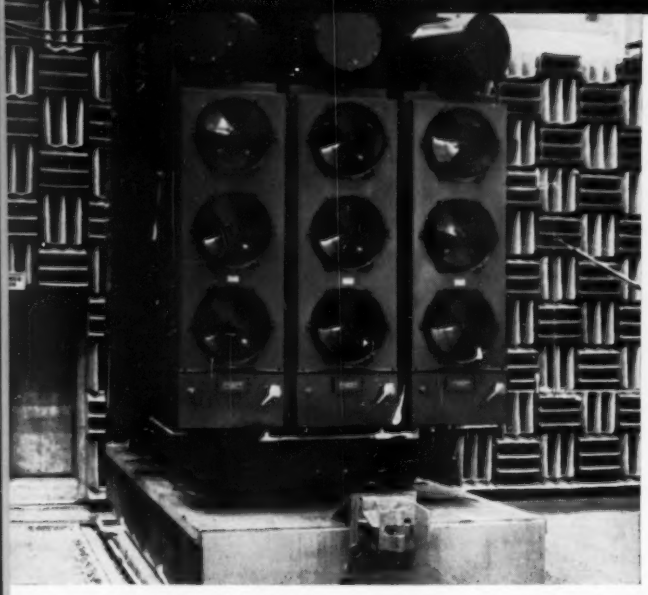
Speed construction by scheduling the arrival and disposition of equipment for maximum installation efficiency and on-time start-up.

Assist in training operators to better understand the full operating capabilities of the equipment.

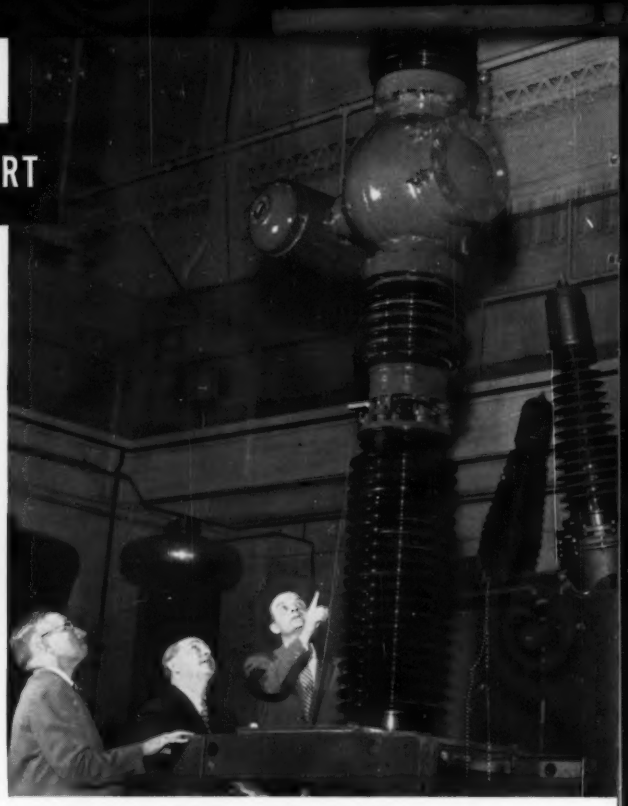
For details, contact your General Electric Apparatus Sales Representative. General Electric Company, Schenectady 5, N. Y. 302-16

GENERAL ELECTRIC

POWER PLANT SERVICES REPORT



FULL-TIME OPERATION of General Electric's Sound Laboratory is helping engineers solve transformer noise problems. Ideal, separate testing area permits accurate measurement of even the slightest gain in sound level reduction.



NEW AIR BLAST POWER CIRCUIT BREAKER forecasts a complete line of such General Electric breakers through 330-kv to help utilities to reduce maintenance costs, and to eliminate scheduled oil filtration and refilling requirements.

Latest G-E product developments point to new advances in cutting system operating costs

Development of a modern air-blast power circuit breaker which promises maintenance savings, and full-time operation of General Electric's multi-million dollar Sound Laboratory—these are just two of many recent events at General Electric that serve to spotlight the technological advances being made every day to improve steam turbine-generators, switchgear, transformers, motors, controls, instruments and other electrical apparatus needed in power stations. And they signify General Electric's continuing program to provide electric utilities with a positive answer to overcome constantly rising system costs.

RECORD EXPANSION INVESTMENT

How far will this program go? The answer is dramatically illustrated by the fact that General Electric's record $175 million investment earmarked for expansion of laboratory and manufacturing facilities during 1956 is well on the road to fulfillment.

TEAMWORK IN PLANNING STAGES

As the trends in power station equipment continue to require higher ratings, improved efficiencies, and to maintain reliability, the advantage of selecting General Electric apparatus, compounded with the time-saving, money-saving benefits of G-E engineering teamwork, offers electric utilities a striking example of why it pays to call in G.E. early in your planning. 302-16

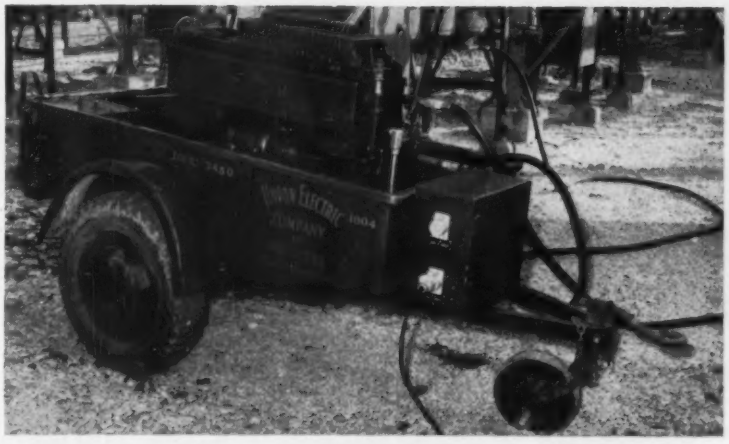
MORE POWER TO AMERICA

GENERAL ELECTRIC

SUBSTATION—Maintenance

Mobile Equipment Speeds Oil Maintenance

KENNETH F. BUEL, Assistant Superintendent of Maintenance, Substations Department, Union Electric Co of Missouri, St. Louis, Mo.



An oil filter truck, an oil filter trailer, and a tank trailer of 1,000-gal capacity are used by the substations department of the Union Electric Co of Missouri for insulating oil maintenance. The truck is used on most major equipment, and the tank trailer when oil must be drained from a large piece of equipment in a remote area. The 1,000-gal tank trailer can be supplemented by a 250-gal elliptical-shaped aluminum tanks on flat cradle mountings.

For filtering, reconditioning, and testing oil, the oil filter truck is brought as close as practicable to the unit serviced, a synthetic rubber 1¼-in. dia hose is unreeled and attached to the equipment and to the filter press suction and discharge piping connections. A cord connects to a 230-v, 3-phase power source.

The filter press is of standard design, 12-in. size, with a motor-driven gear pump having a 30-gpm capacity. The filter, permanently attached to the truck, can be connected to a 100-gal oil storage tank. The truck has ample space for changing blotters and operation of the filter and sufficient head room for a man to stand erect. Blotters are oven-dried at headquarters, placed in a can, immersed in insulating oil, and sealed by a compression cover.

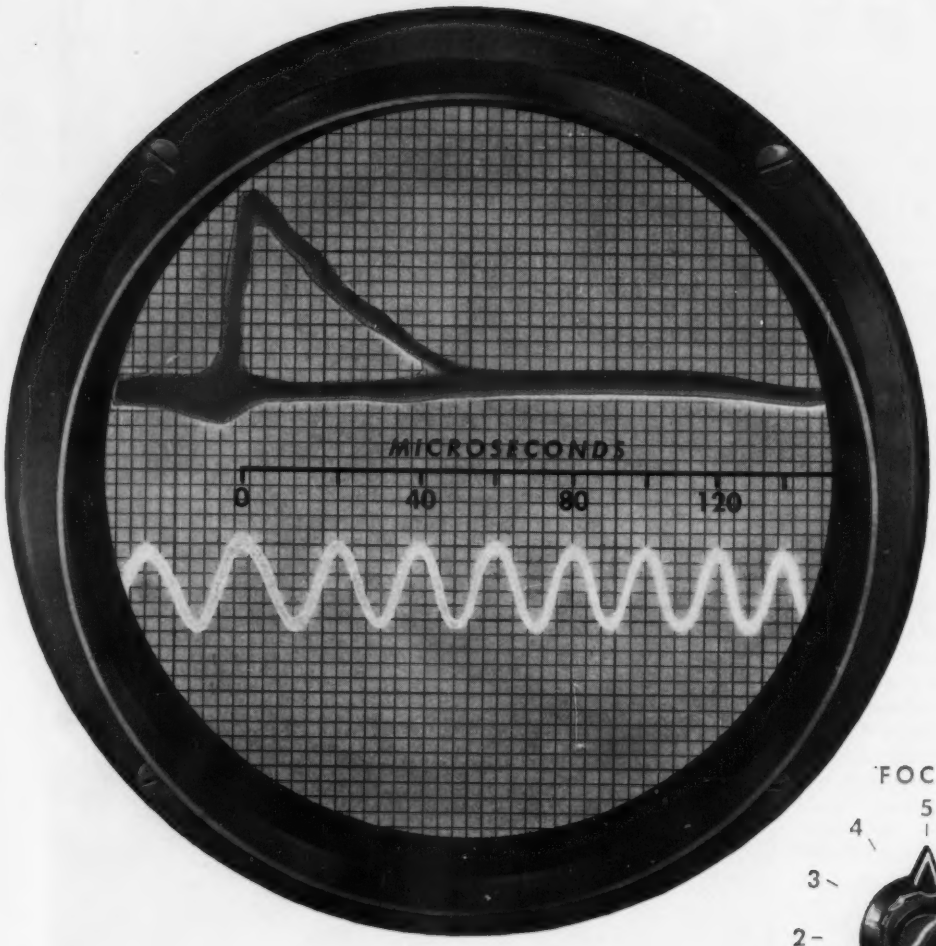
Oil is given a dielectric test, and a microhm resistance test makes contact resistance measurements on breaker contacts.

The oil filter press on the trailer is identical with the truck's. Replacement blotters are carried in sealed cans at the rear. A power converter for selecting a power supply is at the front of the trailer. Where 3-phase power is not available, a single-phase source is used and by manipulation of switches, a power converter is placed in series with the motor. This converts to 3-phase current wth practically a true phase angle of 120 deg.

(*More How To on page* 160)

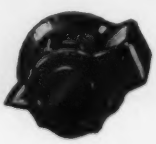
DISTRIBUTION TRANSFORMERS

THIS IMPULSE TEST



FILAMENT

SCREEN LIGHT



EXCITATION

COULD SAVE YOU...$45

Estimate your possible savings in terms of all transformers on your lines

When General Electric started production-line impulse testing its distribution transformers in 1946 more than 15% of the units were rejected. These units had previously passed **all other tests.** Had these transformers been shipped, they might have given years of satisfactory service under normal conditions, or they might have failed under sudden stress.

By weeding out failures in advance it is conservatively estimated that the average life of distribution transformers is increased 15%. Based on the cost of a 25-kva, 2400-volt unit this means a $45 saving on each transformer.

Impulse testing makes the difference. Every unit 100 kva and below has both high- and low-voltage windings tested on the G-E production line without lightning protection of any kind. Any hidden weakness is detected automatically and the faulty transformer is rejected. This means that every G-E distribution transformer you add to your system has already been proven under greater stresses than encountered in normal service.

Look at the other money-saving features that prove "All transformers are not alike": **One-piece clamping bands,** for instance, save maintenance time. Reusable **Nitrile rubber gaskets** help save units from contamination. **AL/CU terminals** are designed to prevent both copper and aluminum conductors from loosening. **Strenicor terminal clamps** save terminals from breaking. **Super Melaglyp paint** saves up to two repaintings. **Nationwide warehouses** save utilities heavy inventory expense. **Service shops** can cut your repair and rebuilding costs.

For the complete story contact your nearest G-E Apparatus Sales Office or G-E Agent—or write to General Electric Company, Schenectady 5, New York.

431-36

dollar-saving features prove ATANA*

***ALL TRANSFORMERS ARE NOT ALIKE**
(make this simple comparison and see)

FEATURE	General Electric	Mfr. A	Mfr. B	Mfr. C	Mfr. D	Mfr. E
Production-line impulse testing	√			√		√
Nitrile rubber gaskets	√					√
One-piece clamping band	√					
H-v and l-v terminals handle both copper and aluminum conductors	√					
Strenicor pressure terminal clamps	√					
Super Melaglyp paint	√					
More than 100 warehouses	√	√				
Nationwide, company-operated service shops	√	√				

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric offers new single-cycle BWR* for atomic power plants

Designed specifically to furnish energy for electric power generation

Forerunner of a whole new family of small power reactors, the General Electric single-cycle boiling water reactor is a new source of energy designed for power plants in a range of 5000 to 20,000 kw. It can be modified for larger ratings.

Boiling in the reactor itself and forced circulation offer these advantages:

(1) Simplified design; no main heat exchanger used. **(2)** High thermal efficiency. **(3)** Automatic control of response to load changes. **(4)** Greater safety since reactor is self-limiting in case of excessive nuclear reactivity.

This reactor uses fuel elements of the long-burnup type. Spent fuel elements are stored in the service pool adjacent to the reactor until cool enough for futher handling.

The reactor and service pool can be equipped for neutron and gamma irradiation for research without interfering with reactor operation.

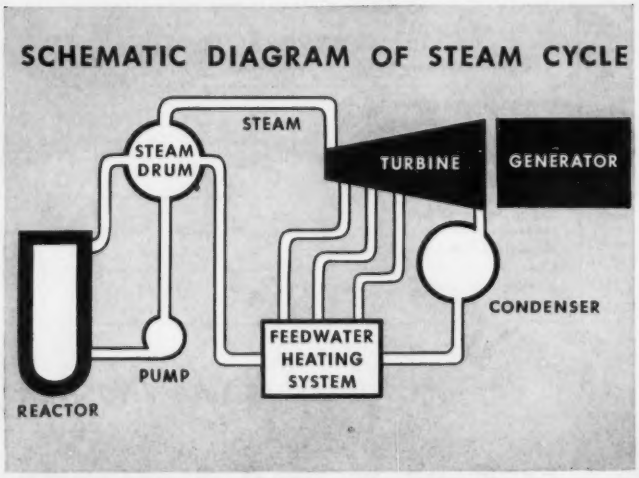
For more information, write for bulletin GER-1220, Sect. 192-7, or contact the Atomic Power Equipment Dept., General Electric Co., Schenectady 5, N. Y.

**Boiling Water Reactor*

Progress Is Our Most Important Product

GENERAL ELECTRIC

SIMULATED FUEL ELEMENT being installed in a heat transfer loop for tests under reactor thermal conditions. This is one of G.E.'s supporting atomic development programs to advance reactor design.



STEAM FLOWS FROM REACTOR to drum. Saturated steam passes to turbine; water goes to feedwater heaters and returns to steam drum. Forced circulation pump provides automatic control of response to load changes.

STEAM DRUM
TURBINE-GENERATOR
FEEDWATER HEATERS
REACTOR
GENERAL ELECTRIC

Car Dumping Controls Fit Needs Ahead

Coal handling equipment at the new Eastlake power plant of the Cleveland Electric Illuminating Co will have to work longer and probably harder to satisfy a 50% increase in tonnage requirements which will be necessary upon completion soon of the plant's fourth turbogenerator unit —a 240,000-kw giant.

More than 100,000 tons of coal are unloaded each month, using an automatically controlled revolving car dumper which unloads one 100-ton railroad hopper car at a time at a maximum rate of 40 such cars an hr.

In anticipation of the plant's further expansion, the drive installed for the car dumper was made large enough to handle a substantial increase in service. A 100-hp, wound-rotor motor was selected, along with 440-v a-c reversing-plugging type automatic motor starters.

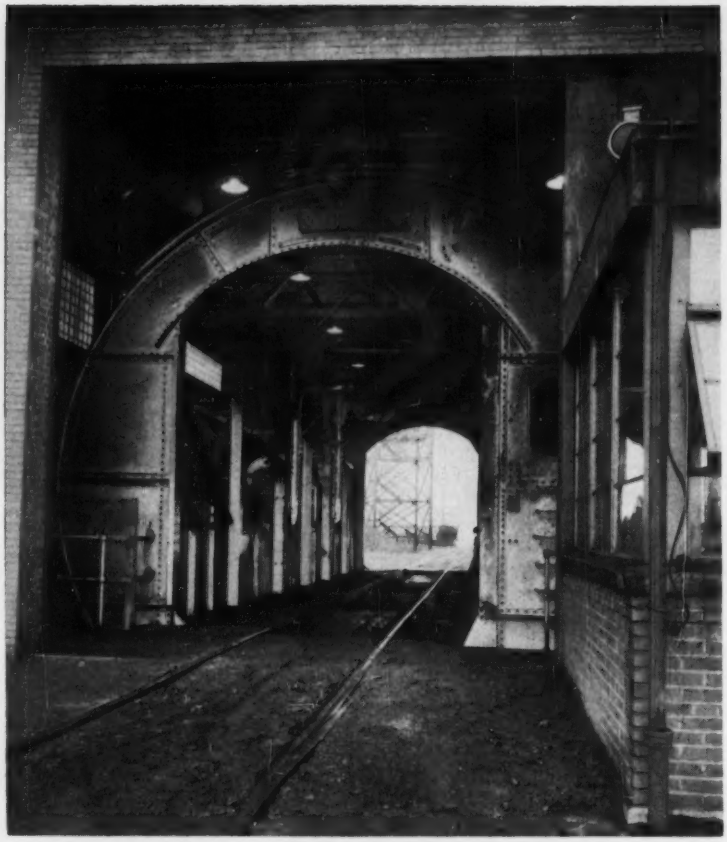
The latter are mounted in weather-resistant enclosures in a sub-basement of the dumper house. Weather resistant enclosures are needed because of the large door openings at each end of the building which permit the hopper cars to enter and exit.

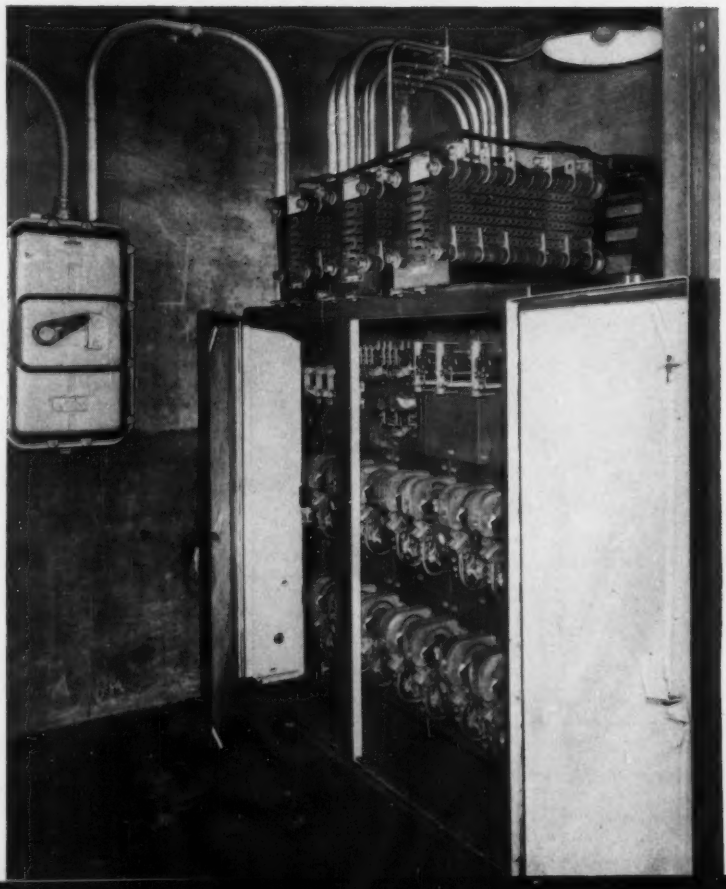
The operator's station is in a brick-and-glass structure at the building entrance away from the heavy coal dust concentrations inside the building. It allows a full view of the dumping equipment. For the operator's safety, motor control circuits utilize 110-v a-c current. A limit-switch-actuated magnetic brake connected to the control circuits automatically slows and stops the dumper as the car reaches the inverted position, and again when the car is returned to the upright position.

The complete dumping cycle takes only 45 sec.

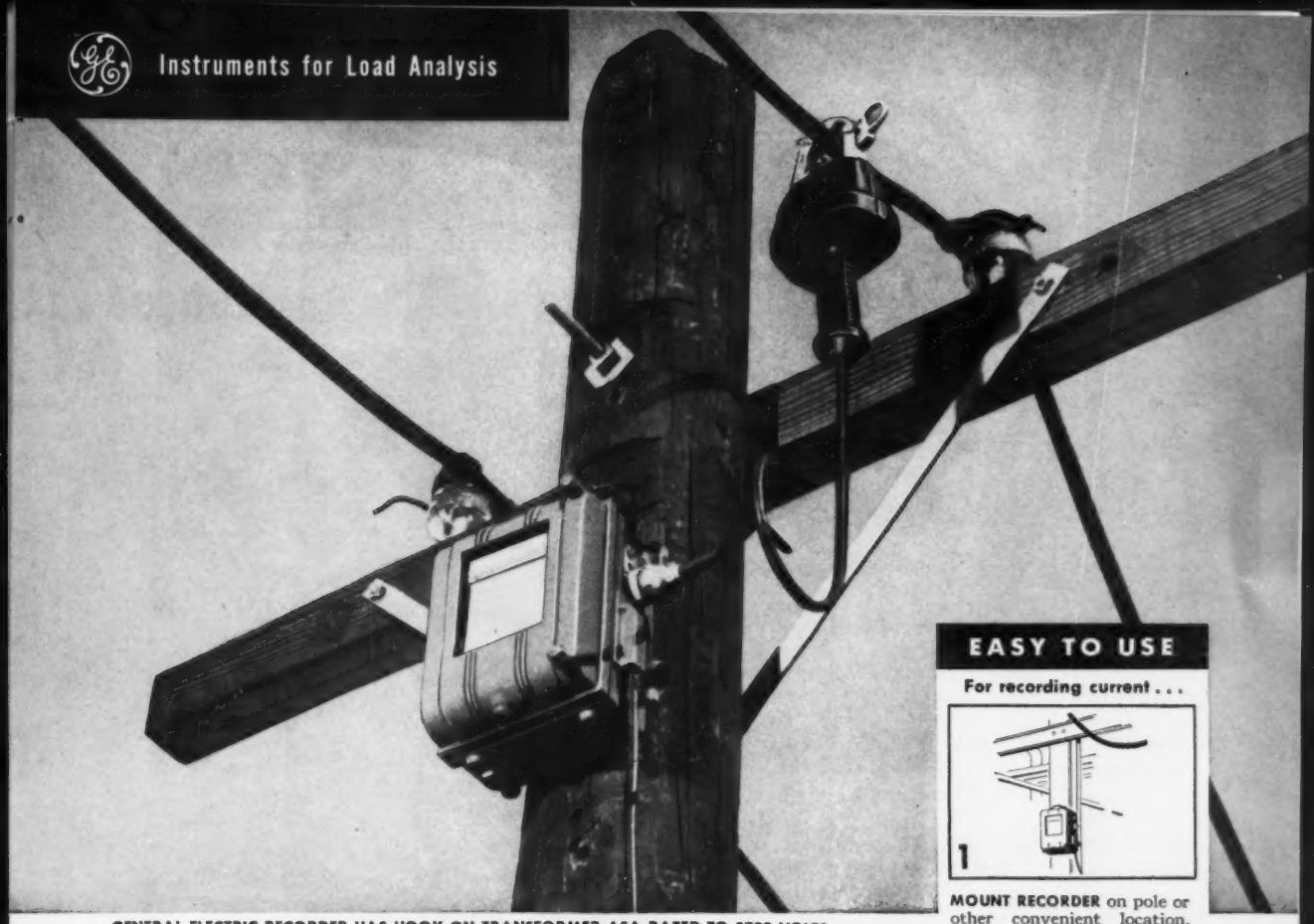
Coal dumped from the hopper cars is fed to a belt conveyor system which transports the coal to a crusher and then either into the plant or to a nearby storage pile.

(*More How To on page* 166)





Instruments for Load Analysis



GENERAL ELECTRIC RECORDER HAS HOOK-ON TRANSFORMER ASA RATED TO 8700 VOLTS

Here's an Easy Way to Help Solve Coming Electrical Load Problems

G-E inkless recorder allows fast hook-on installation; can operate continuously for 30 days without attendance

FOR LOAD ANALYSIS, the General Electric CF-7 hook-on recorder provides an easy way to obtain accurate records of electrical loads. This versatile instrument can measure and record either current or voltage without interrupting service. Fast, convenient, hook-on installation and the ability to operate continuously for 30 days without attendance make the recorder ideal for checking growing commercial and industrial loads.

INSTALLATION of the lightweight, portable instrument for recording either current or voltage requires only four simple steps. (See explanation at right.) Once the recorder is installed, little servicing is necessary other than replacing record rolls. Inkless recording means that there are no messy inkwells to clean. Weatherproof for dependable outdoor use, the recorder can operate accurately in a wide range of ambient temperatures. You can use the CF-7 recorder in any one of seven ranges: 15/75/150/750 amperes, a-c; and 150/300/750 volts, a-c. The butyl-molded hook-on transformer is ASA rated up to 8700 volts and the transformer secondary is short-circuit protected for operating safety.

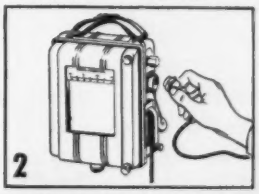
SEE FOR YOURSELF how the General Electric CF-7 hook-on recorder can help solve coming electrical load problems. Write Section 582-14, General Electric Co., Schenectady 5, New York, and ask for bulletins GEA-6104 and GEC-215, or contact your nearest G-E Apparatus Sales Office.

GENERAL ELECTRIC

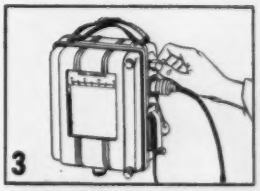
EASY TO USE

For recording current . . .

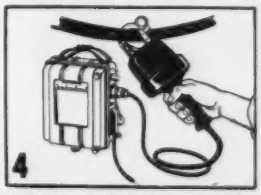
MOUNT RECORDER on pole or other convenient location. Connect recorder to either 120-volt or 240-volt power supply (50 or 60 cycles).



CONNECT TRANSFORMER LEAD to special socket on the side of the recorder.



SELECT PROPER RANGE by setting selector switch for 15, 75, 150, or 750 amperes.



HOOK CURRENT TRANSFORMER on the conductor which is to be checked.

General Electric Announces . . .

Two new series of Thyrite Magne-valve distribution arresters are shown by R. T. Morris, manager, Lightning Arrester and Cutout Sales. Top row shows directly-connected type: bottom row shows externally-gapped type.

.....A COMPLETE NEW LINE OF MAGNE-VALVE DISTRIBUTION ARRESTERS

Smallest, lightest, valve-type arresters, with a proven operating principle that assures maximum system protection

Intensive General Electric research into improved lightning protection for distribution circuits has now resulted in a new and advanced line of valve-type arresters—the only type that can be applied anywhere on a system regardless of available short-circuit current.

For the first time in distribution arresters, you get the advantages of the exclusive Magne-valve principle so successfully used in G-E station-type and line-type arresters—a combination of *magnetic* action of series gaps to augment the *valve* action of time-proven Thyrite* disks, giving the highest degree of protection ever offered for distribution circuits.

Smaller size and weight of these new arresters—only a fraction of that of comparable arresters—is a further advantage of the new design. They are intended for separate mounting to crossarm or direct-to-pole.

Ratings from 9 kv thru 18 kv are available in a choice of either the external-gap type—or direct-connected type with ground-lead disconnector. Both types give the best in overvoltage protection and both types provide positive protection against line-lockouts. Pellet-type arresters will still be available in voltage ratings 3 kv–15 kv to all users.

For full details of the new line of distribution arresters, check your nearest G-E Apparatus Sales Representative or write to General Electric Company, Schenectady 5, New York. Ask for bulletin GEA-6379. 433-17

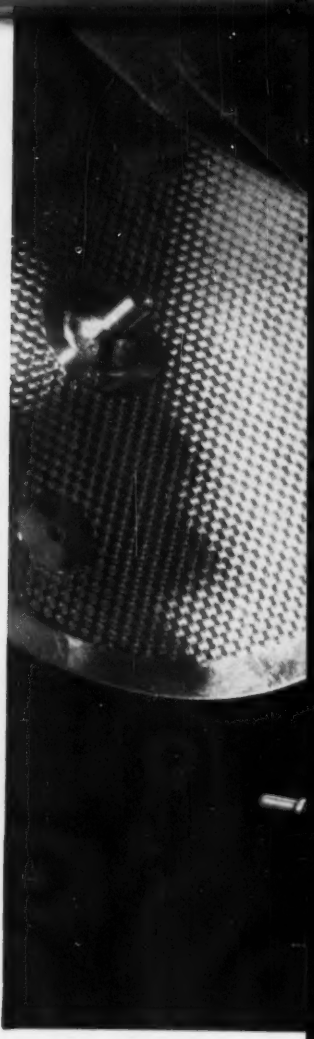
*Reg. Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

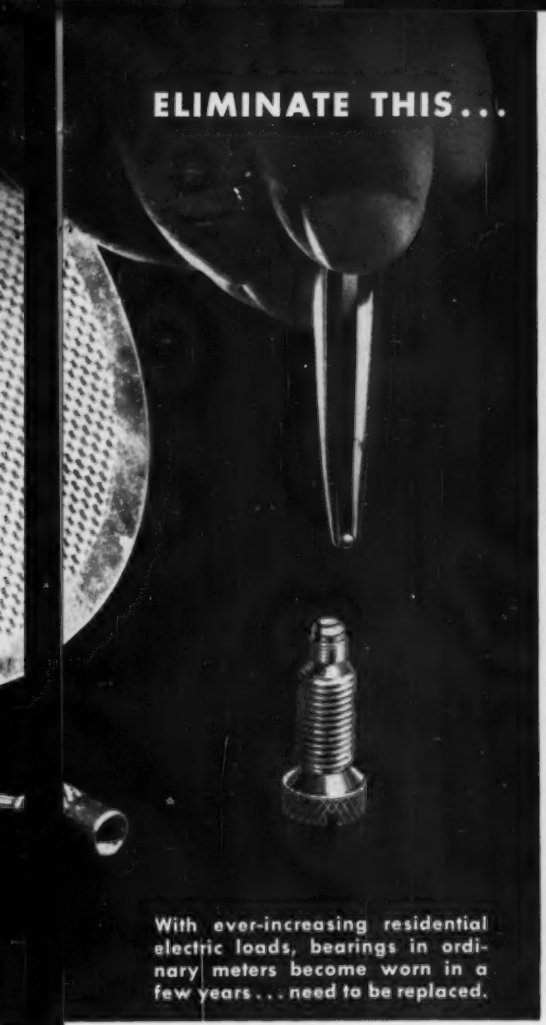
Life tests prove . . .

No Bearing Replacement

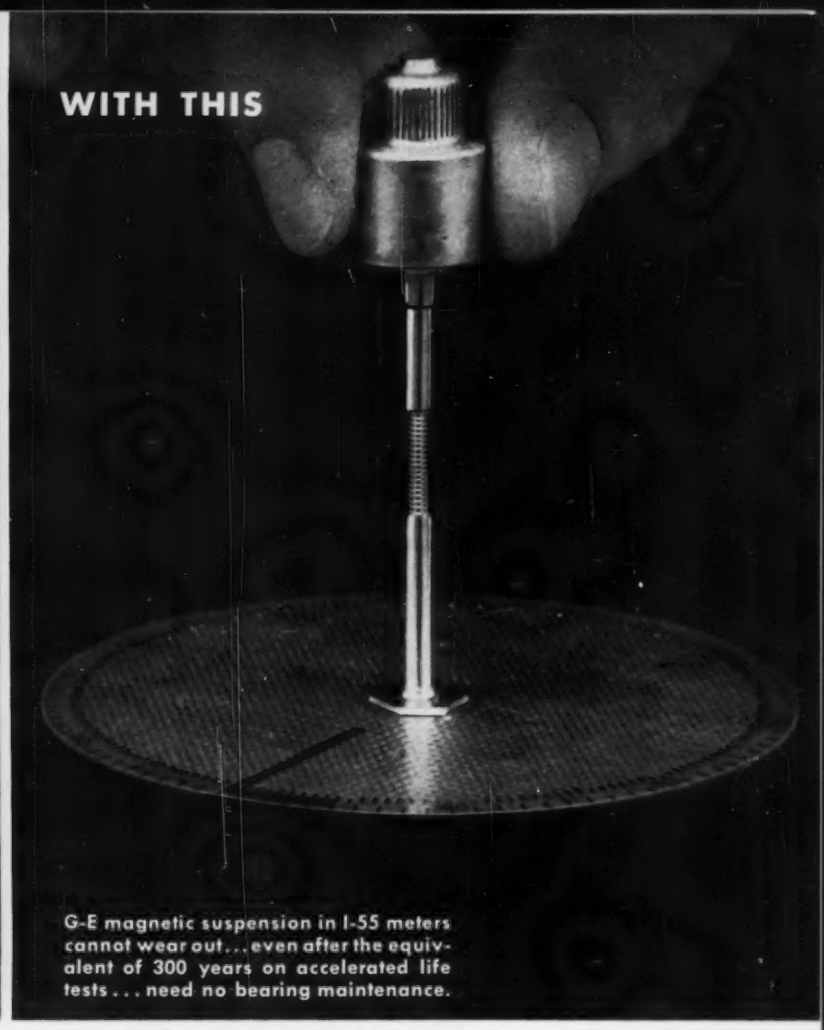


G.E.'s NEW "PERFECT PARTNER" . . .

the S-1 square meter socket, designed for use with extended-range meters such as the G-E I-55 on installations up to 100 amps.



With ever-increasing residential electric loads, bearings in ordinary meters become worn in a few years . . . need to be replaced.



G-E magnetic suspension in I-55 meters cannot wear out . . . even after the equivalent of 300 years on accelerated life tests . . . need no bearing maintenance.

G-E MAGNETIC SUSPENSION LOWERS METERING COSTS BY ELIMINATING BEARING REPLACEMENT

The trouble and expense of periodic bearing replacement is eliminated when you use General Electric meters with the revolutionary "floating disc." This fact was firmly established in a series of continuing accelerated life tests conducted at General Electric research laboratories. During these tests, identical loads were applied to ordinary meters using conventional ball bearings to support the weight of the moving element and to G-E meters with magnetic suspension.

HERE IS WHAT THE TESTS REVEALED:

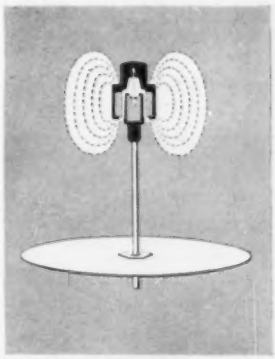
1. The ball bearings in ordinary meters must be inspected, and in many cases replaced, after a comparatively short period of time. Bearing wobble, excessive noise, and inaccurate performance necessitated removing the meters from the line and replacing their bearings.

2. The magnetic suspension system in the G-E meters—even after the equivalent of more than 300 years' operation—showed no measurable wear whatsoever.

These tests substantiate the perfect record of the more than 6 million G-E I-50 meters in service today. They offer proof that G-E meters with magnetic suspension lower your metering costs by eliminating bearing replacement, and by more accurately measuring all the power you supply.

For the meter which will pay for itself time and time again through reduced maintenance expenses alone, specify those of the General Electric I-50 family . . . the only meters with the "floating disc."

For more information contact your nearby General Electric Apparatus Sales Office, or write General Electric Company, Section 621-6, Schenectady 5, N. Y.



MAGNETIC SUSPENSION of the rotor eliminates conventional bearings, thereby greatly reducing maintenance and replacement costs.

Progress Is Our Most Important Product

GENERAL ELECTRIC

TRANSMISSION—Maintenance

Work Cage Travels Guys Of High Masts

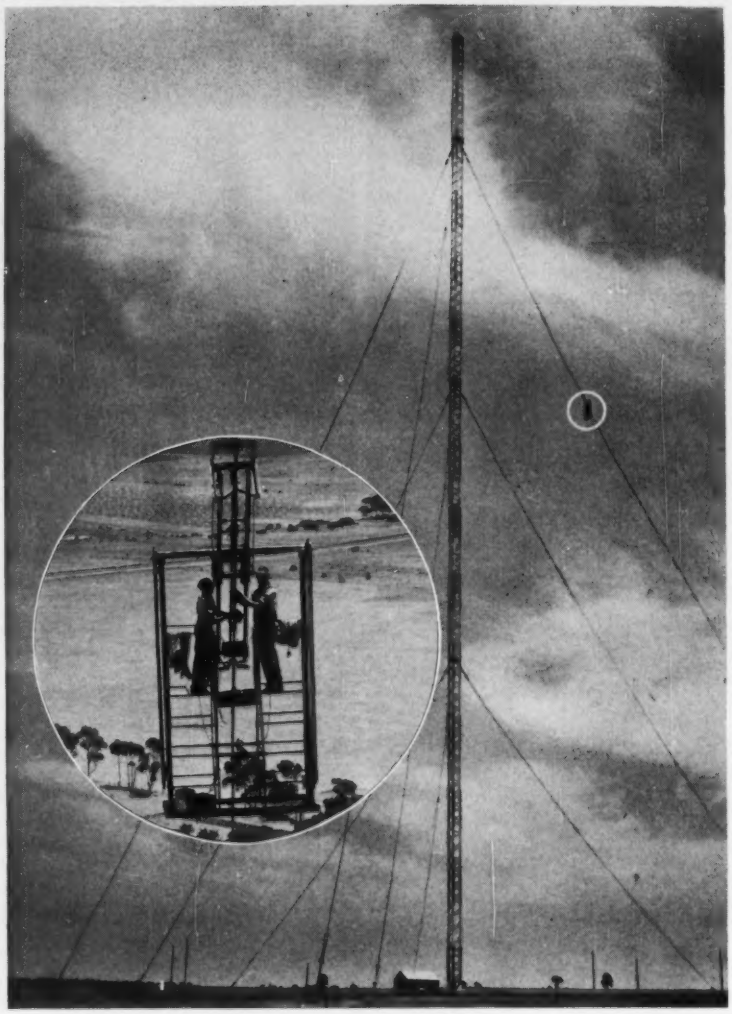
The problem of inspecting high steel-guyed radio and electric masts closely has been solved by the invention of an Australian manufacturer.

Previously guys and their procelain insulators were observed through a telescope from ground level, an inspection method involving inaccuracies and difficulties. What the designers wanted was a device that would actually travel along the guy ropes and accommodate two men for carrying out the inspection and making repairs. They developed an inspection cage fitting these needs.

The cage, holding two men, is raised or lowered along the guys by means of a wire rope halyard connected to a winch at the foot of the mast. An important feature is the escape gear fitted to the cage for allowing the men to be lowered to the ground from the cage should it become entangled.

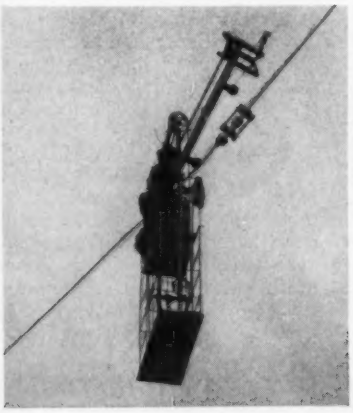
As porcelain insulators and their assemblies are relatively fragile, it was essential to avoid knocking or fracturing them in any way. The Australian cage actually "hops over" the insulator assemblies. It is made of light tubular steel, and the patented item has been used successfully on masts as high as 710 ft.

(*More How To on page* 170)

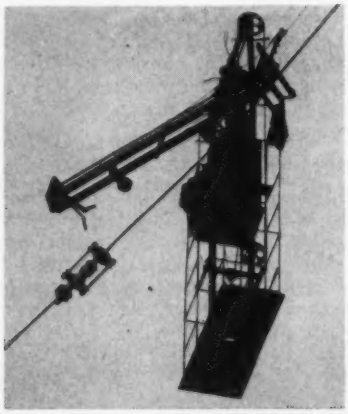


INSPECTION APPARATUS (ringed) travels up the top guy of 710-ft radio mast. Workmen raise cage by wire rope halyard. Action seen from mast platform

CAGE as it ascends guy approaches a porcelain insulator in its path



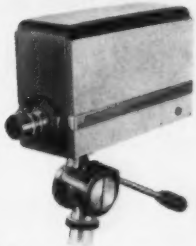
CREW tilts the cage in preparation for laying special track over an obstacle



PAST THE INSULATOR, the device continues upward along guy line of mast

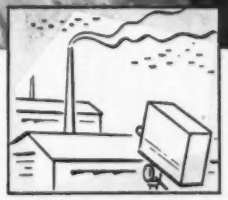
New Kind of Production Insurance!

PHILCO Industrial TV Pays Off *before* the Emergency

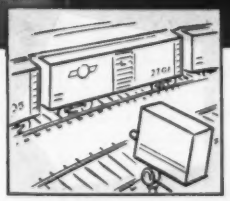


Now, from one central location you can keep constant watch over critical points in your operation . . . and *prevent* dangerous conditions, equipment failures and tie-ups from becoming emergencies. At the flick of a switch Philco Industrial Television brings right before your eyes, the remote operation you want to check *clear as life!*

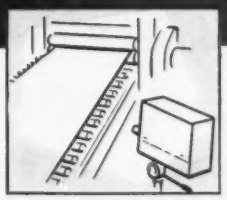
- **Compact, lightweight Philco TV Camera capable of horizontal resolution up to 600 lines produces high-definition pictures at low light levels.**
- **Full remote control of cameras. Tilt them, pan them, focus them, or "ZOOM-IN" for a closer look . . . all from one control point.**
- **Choice of 10-inch or 17-inch monitors for desk console, or for rack or wall mounting. All monitors are self-contained and use ALUMINIZED cathode ray tubes for maximum brightness.**
- **Designed for easy, economical system expansion.**



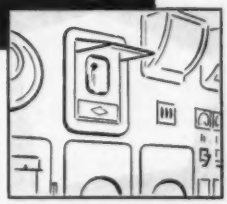
The Philco ITV system affords constant protection of property in power plants and factories of every type.



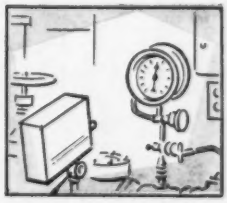
Keeps a watchful eye on important cargo shipments both night and day whether by rail, truck or air freight.



Scans production lines. Ideal for steel, paper, automobile . . . many other continuous process industries.



Gives clear pictures of operations too dangerous for personal observation. Ideal for group instruction.



Views gauges and meters for any type of operation, and presents clear sharp pictures at remote locations.

Mail coupon for full information

PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44 PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario

Philco Government and Industrial Division
Dept. EW, Philadelphia 44, Pa.

Please send me information on Philco Industrial TV for the following application:

_____

Name_____ **Title**_____

Company_____

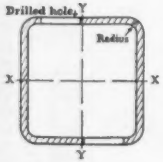
Address_____

City_____ **Zone**_____ **State**_____

Ventilated Square Copper Bus Tubes: Ratings

Data for square copper bus tubes with perforated walls are an adaptation from a book on electrical conductors issued by American Brass Co

Nominal Size, In.	Outside Dimensions, In.			Wall Thickness, In.	Drilled Holes		Weight, Pounds per Foot	Average Cross-Section (a)		With Respect to X-X Axis			With Respect to Y-Y Axis			D-C Resistance, Microhms per Foot at 20 C (68 F) (c)	Skin-Effect Ratio (d)	60-Cycle Current Rating, Amperes (e)
	Square	Diagonal	Corner Radius		Diameter, In.	Spacing, Center to Center, In.		Square In.	Thousand Cir. Mils	Moment of Inertia (b), In.^{4}	Section Modulus, In.^{3}	Radius of Gyration, In.	Moment of Inertia (b), In.^{4}	Section Modulus, In.^{3}	Radius of Gyration, In.			
3 x 1/8	3.00	3.934	0.375	0.125	1¼	4	5.00	1.294	1647.	1.189	0.7924	1.060	1.697	1.131	1.266	6.46	1.02	2030
3 x 3/16	3.00	3.934	0.375	0.1875	1¼	4	7.36	1.904	2424.	1.671	1.114	1.038	2.390	1.593	1.242	4.39	1.04	2430
3 x ¼	3.00	3.934	0.375	0.250	1¼	4	9.62	2.489	3169.	2.087	1.391	1.017	2.993	1.995	1.218	3.35	1.07	2720
3 x 5/16	3.00	3.828	0.500	0.3125	1¼	4	11.53	2.983	3798.	2.306	1.537	0.9814	3.545	2.363	1.217	2.79	1.12	2910
3 x ⅜	3.00	3.828	0.500	0.375	1¼	4	13.55	3.506	4464.	2.589	1.726	0.9618	4.001	2.668	1.196	2.38	1.19	3040
3 x ½	3.00	3.721	0.750	0.500	1¼	4	16.48	4.264	5429.	2.619	1.746	0.8880	4.313	2.875	1.140	1.95	1.38	3120
4 x 1/8	4.00	5.243	0.500	0.125	1½	4	6.70	1.733	2207.	3.066	1.533	1.445	4.157	2.078	1.682	4.83	1.03	2620
4 x 3/16	4.00	5.243	0.500	0.1875	1½	4	9.90	2.563	3263.	4.386	2.193	1.423	5.955	2.977	1.658	3.26	1.06	3130
4 x ¼	4.00	5.243	0.500	0.250	1½	4	13.01	3.368	4288.	5.575	2.787	1.401	7.579	3.790	1.634	2.47	1.09	3520
4 x 5/16	4.00	5.243	0.500	0.3125	1½	4	16.03	4.149	5282.	6.651	3.325	1.381	9.041	4.521	1.610	2.01	1.15	3800
4 x ⅜	4.00	5.243	0.500	0.375	1½	4	18.95	4.905	6245.	7.594	3.797	1.359	10.35	5.175	1.587	1.70	1.23	3990
4 x ½	4.00	5.035	0.750	0.500	1½	4	23.68	6.129	7804.	8.439	4.220	1.290	12.07	6.037	1.543	1.36	1.46	4040
5 x 1/8	5.00	6.450	0.750	0.125	1⅞	4	8.35	2.160	2751.	6.291	2.516	1.827	7.981	3.192	2.058	3.87	1.03	3190
5 x 3/16	5.00	6.450	0.750	0.1875	1⅞	4	12.38	3.204	4079.	9.089	3.636	1.805	11.53	4.613	2.034	2.61	1.07	3820
5 x ¼	5.00	6.450	0.750	0.250	1⅞	4	16.32	4.223	5376.	11.67	4.668	1.783	14.81	5.924	2.009	1.97	1.11	4290
5 x 5/16	5.00	6.450	0.750	0.3125	1⅞	4	20.16	5.217	6642.	14.05	5.619	1.762	17.82	7.130	1.985	1.60	1.17	4640
5 x ⅜	5.00	6.450	0.750	0.375	1⅞	4	23.90	6.186	7877.	16.23	6.492	1.725	20.59	8.236	1.943	1.35	1.25	4870
5 x ½	5.00	6.450	0.750	0.500	1⅞	4	31.11	8.052	10250.	20.06	8.022	1.699	25.90	10.36	1.931	1.03	1.51	5050
6 x 1/8	6.00	7.864	0.750	0.125	1¾	4	10.20	2.640	3361.	11.76	3.920	2.236	14.18	4.726	2.455	3.17	1.05	3760
6 x 3/16	6.00	7.864	0.750	0.1875	1¾	4	15.16	3.923	4994.	17.11	5.703	2.213	20.62	6.872	2.430	2.13	1.08	4500
6 x ¼	6.00	7.864	0.750	0.250	1¾	4	20.02	5.181	6597.	22.12	7.373	2.191	26.64	8.881	2.405	1.61	1.12	5080
6 x 5/16	6.00	7.864	0.750	0.3125	1¾	4	24.79	6.415	8168.	26.81	8.937	2.169	32.27	10.76	2.380	1.30	1.20	5480
6 x ⅜	6.00	7.864	0.750	0.375	1¾	4	29.46	7.624	9708.	31.19	10.40	2.148	37.52	12.51	2.355	1.09	1.28	5760
6 x ½	6.00	7.864	0.750	0.500	1¾	4	38.52	9.970	12690.	39.08	13.03	2.105	47.63	15.88	2.324	0.84	1.54	5980
7 x 3/16	7.00	9.276	0.750	0 1875	1⅞	4	17.93	4.639	5907.	28.78	8.223	2.619	33.56	9.588	2.828	1.78	1.10	5150
7 x ¼	7.00	9.276	0.750	0.250	1⅞	4	23.71	6.137	7813.	37.39	10.68	2.597	43.56	12.45	2.803	1.35	1.15	5780
7 x 5/16	7.00	9.276	0.750	0.3125	1⅞	4	29.40	7.609	9689.	45.53	13.01	2.575	53.01	15.15	2.778	1.09	1.22	6240
7 x ⅜	7.00	9.276	0.750	0.375	1⅞	4	35.00	9.058	11530.	53.23	15.21	2.553	61.91	17.69	2.753	0.91	1.31	6570
7 x ½	7.00	9.276	0.750	0.500	1⅞	4	45.91	11.88	15130.	67.33	19.24	2.509	79.13	22.61	2.720	0.70	1.57	6860
8 x 3/16	8.00	10.692	0.750	0.1875	2	4	20.69	5.354	6816.	44.79	11.20	3.024	51.29	12.82	3.236	1.55	1.11	5850
8 x ¼	8.00	10.692	0.750	0.250	2	4	27.39	7.089	9026.	58.38	14.60	3.001	66.82	16.70	3.211	1.17	1.17	6560
8 x 5/16	8.00	10.692	0.750	0.3125	2	4	34.00	8.800	11200.	71.34	17.84	2.979	81.59	20.40	3.185	0.94	1.24	7090
8 x ⅜	8.00	10.692	0.750	0.375	2	4	40.52	10.49	13350.	83.69	20.92	2.956	95.64	23.91	3.160	0.79	1.33	7470
8 x ½	8.00	10.692	0.750	0.500	2	4	53.27	13.79	17550.	106.6	26.65	2.912	122.8	30.71	3.126	0.60	1.59	7820



Ventilated Square Bus-Conductor Tube

NOTES: Variations from these values must be expected in practice. ASTM Standard Specification B 188, Seamless Copper Bus Pipe and Tube, controls the tensile properties, conductivity, tests and inspection. Dimensional tolerances are agreed between manufacturer and purchaser at the time of placing an order.

(a) The average cross-section in square inches was determined by dividing the weight per foot by 12 times the weight of 1 cubic inch of copper.

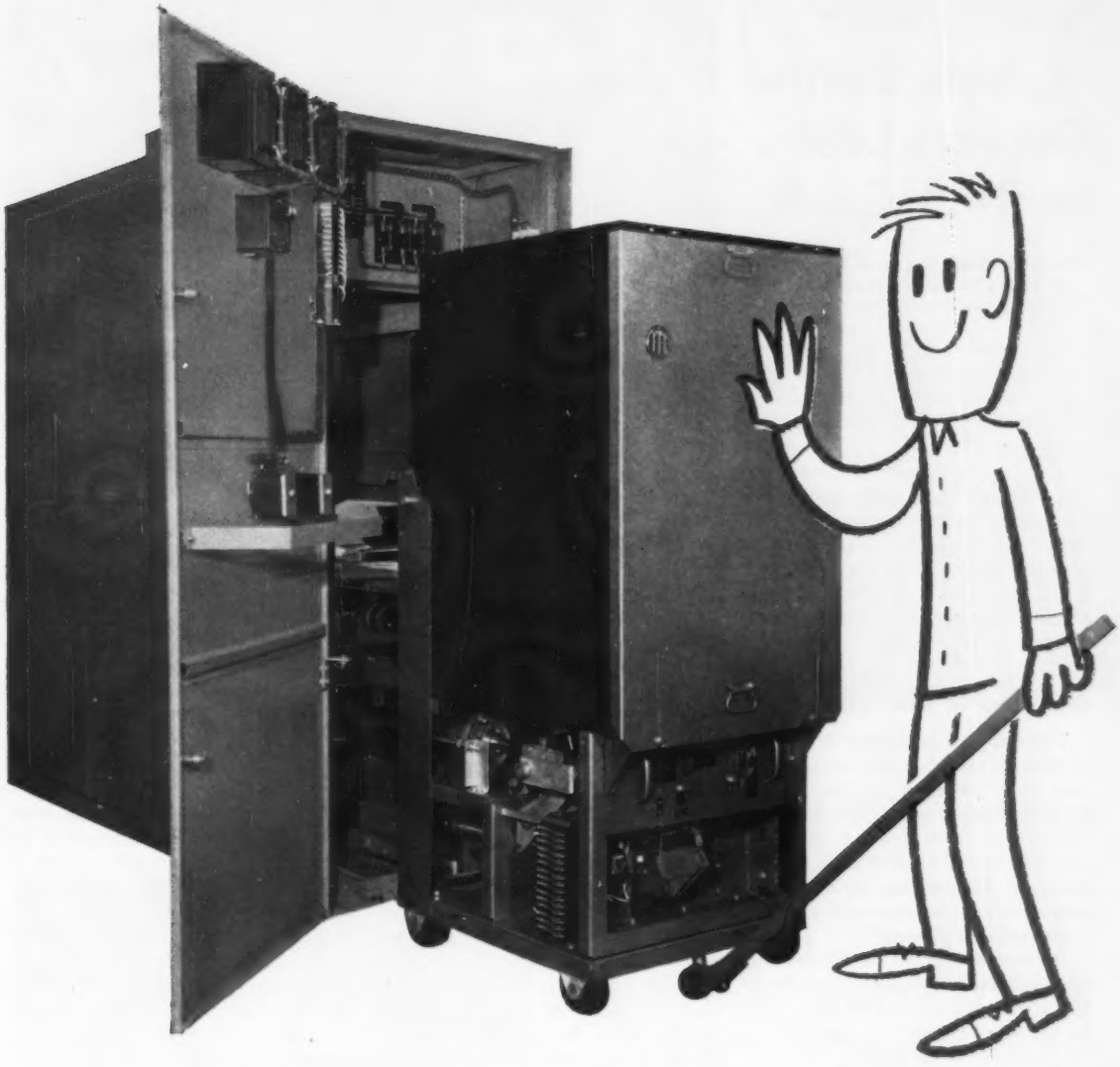
(b) The moments of inertia in this table are those of the minimum transverse sections, those passing through the centers of the ventilating holes. These minimum sections determine the maximum strength of ventilated square tubes as load-supporting members of a structure.

(c) The d c resistances are based on the conductivity requirements of ASTM Specification B 188. The conductivities of square tubes—both solid, and drilled for ventilation—are as follows:

Size	Conductivity
Up to 6 in. outside diam. and up to 3/16 in. wall thickness	97.40% IACS minimum
Up to 6 in. outside diam. and over 3/16 in. wall thickness	97.80% IACS minimum
All sizes over 6 in. outside diameter	98.40% IACS minimum

(d) Skin-effect ratio at 60 cycles per second

(e) 60-cycle current-carrying-capacity ratings have been computed for 30 C temperature rise over still air at 40 C, conductor with new, bright, mill finish, horizontal and free from outside magnetic influences.



I-T-E Metal-Clad Switchgear—positive protection through 500,000 kva

Made in 3 basic voltage ratings (5 kv, 7.5 kv and 15 kv) with interrupting ratings of 150, 250 and 500 mva. Throughout this line of modern gear, time-proved features add extra value. Horizontal drawout circuit breakers are jig fitted to enclosures. Rigid welded frames and housings can be lifted as a unit without loss of alignment. Use of porcelain and epoxy insulation, plus complete isolation of compartments, provides safety and continuity of service.

Why not take advantage of I-T-E quality—it means years longer trouble-free service in your plant. For more information, contact your nearest I-T-E sales office. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

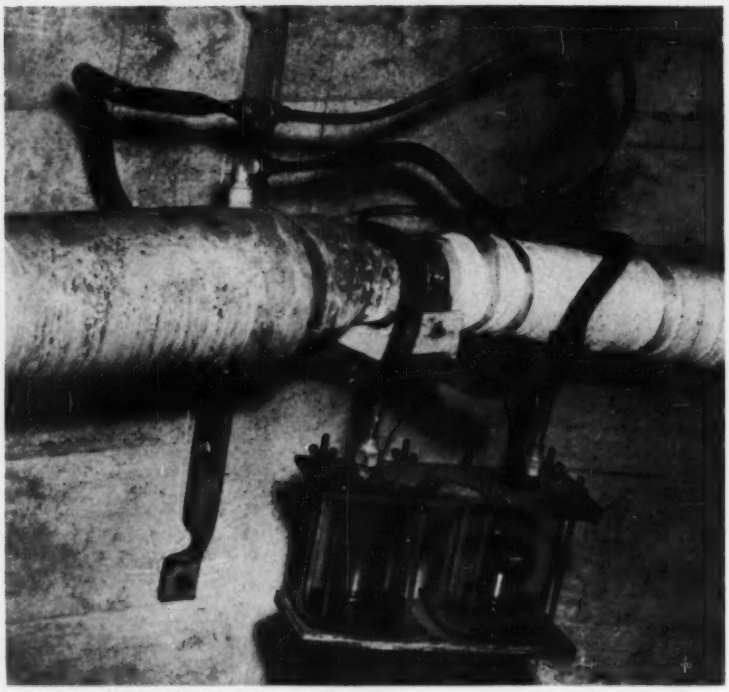
I-T-E CIRCUIT BREAKER COMPANY
Switchgear Division

'Bubble Bottle' Detects Leaks In 34.5 Cable

J. L. REDMOND, Operating Engineer, Underground Division, Indianapolis Power & Light Co, Indianapolis, Ind.

Gas leaks in 34.5-kv gas-filled cables on the Indianapolis Power & Light Co system are located in a very short time by a new "bubble-bottle" technique.

These cables emanate from the 132/34.5-kv Center substation where the gas cylinders and manifold for supply gas to the cables are situated. Standard gas pressure for the cables is 12 psi, an alarm sounding when pressure rises above 15 or drops below 10 psi. A pressure drop suggests a leak.



"BUBBLE BOTTLE" is inserted in series with the external by-pass tube on joint casing in a manhole at approximately the midpoint of 34.5-kv gas-filled cable

Cable Valves Shut Off

The first step in seeking the leak is to shut the valves of each cable. Pressure then continues to drop in the cable having the leak. The two good cylinders are connected to a full nitrogen cylinder and brought up to normal pressure. The leaking cable is then connected to a separate cylinder and fed at reduced pressure.

A "bubble bottle," a homemade flow indicating device, is inserted in series with the external by-pass tube on the joint casing in a manhole, at the midpoint of the cable.

Pressures Fixes Levels

The "bubble bottle" is made of two plexiglass cylinders open at each end and clamped against copper plates. Each end of the plexiglass cylinder rests on Neoprene gaskets. The bottom plate has a ¼-in. oil channel between the two plexiglass cylinders, and enough light-weight oil is added to each cylinder to cover the bottom. The slightest pressure difference causes a difference in the two oil levels. The pressure is lower in the cable section with the higher oil level, and the oil bubbles when the pressure difference forces all of it into one bottle.

As connection of the "bubble bottle" entails loss of gas from the cable, time must be allowed for the pressure to stabilize before the gas flow indication is reliable. Meanwhile other manholes are checked for hissing audible whenever a leak is large.

When the leak is not found by inspection, a second "bubble bottle" is connected at the midpoint of the section known to have the leak. By moving one bottle at a time the length of cable is halved progressively until the bottles are in adjacent manholes and indicate opposite directions of flow. This means the gas is flowing to one joint from both directions.

The leak is located in the joint by brushing the solder wipes and the sheath with liquid soap. Even very slow leaks are revealed by the bubble action in the suds.

(*More How To on page* 175)

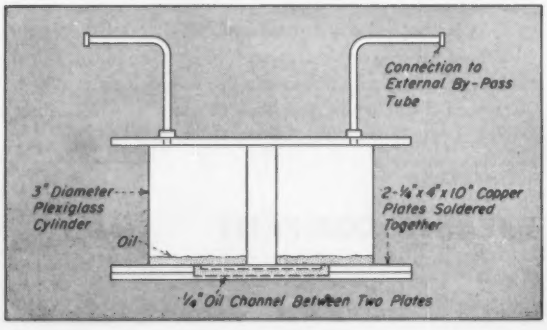

Connection to External By-Pass Tube
3" Diameter Plexiglass Cylinder
Oil
2-¼"x 4"x 10" Copper Plates Soldered Together
¼" Oil Channel Between Two Plates

FIG 1—BUBBLE BOTTLE consists of two plexiglass cylinders open at each end and clamped to copper plates

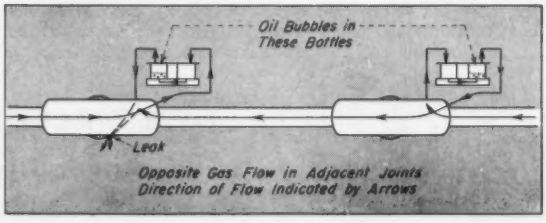
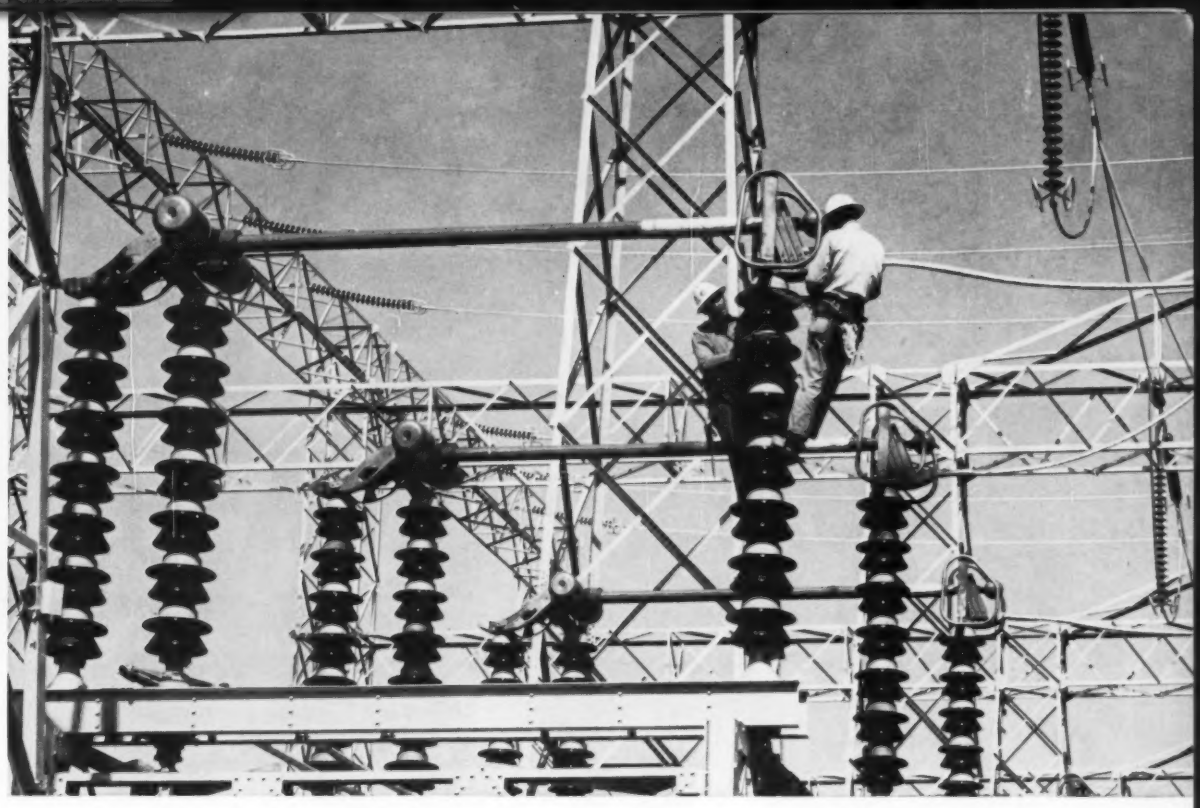
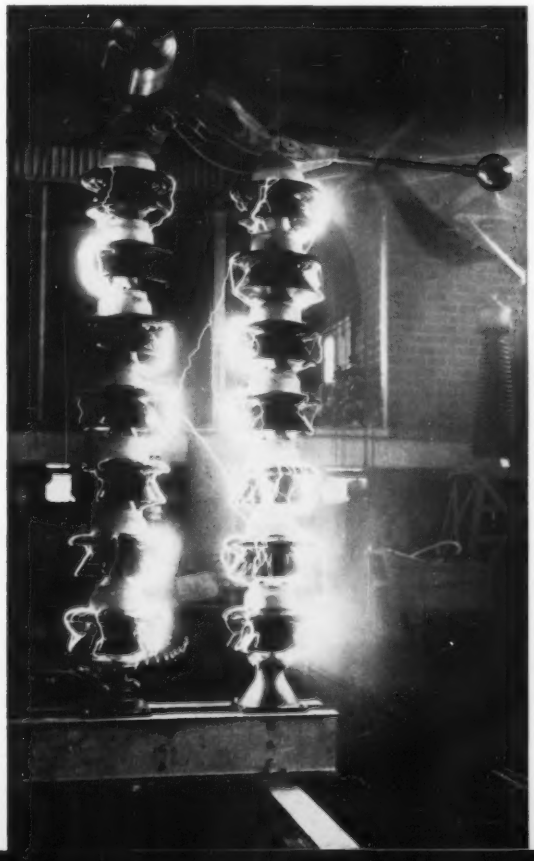


FIG 2—OPPOSITE GAS FLOW in adjacent joints indicates direction of leak. Arrow shows direction of gas flow



330-kv Switches Built With O-B Pincaps



Standard O-B pincap insulators exceeded every mechanical and electrical test called for in the design of these 330-kv air-break switches. Materials were examined thoroughly—complete 60-cycle wet and dry flashover and withstand, corona, and complete impulse testing guided the switch design, and eventually confirmed it.

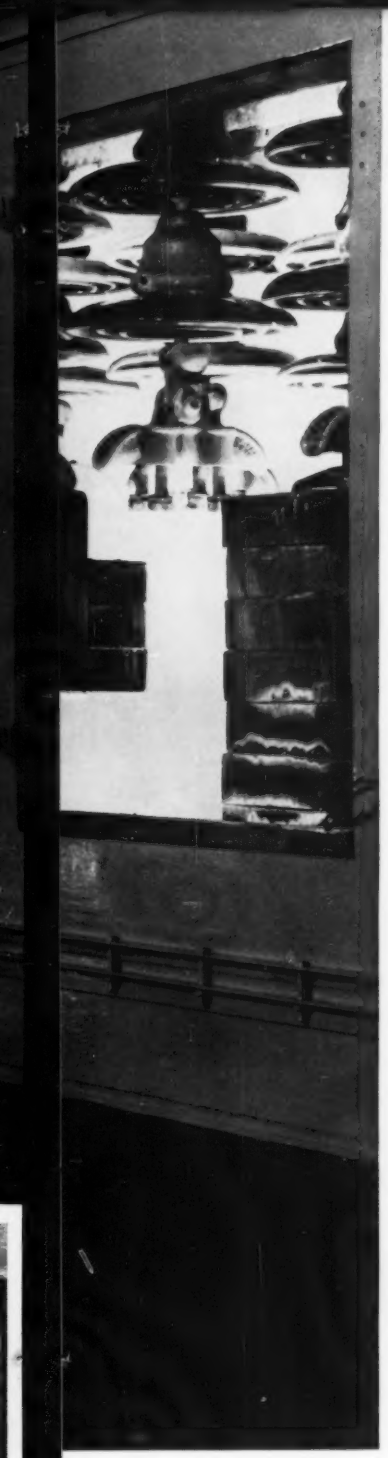
Similar testing has confirmed the choice of O-B suspension insulators and hardware for use at 330 kv.

Since dependence placed on EHV systems is so great that the builders require materials of *proved* value, it is worthwhile to point out that only Ohio Brass maintains an organization which designs, produces, tests and evaluates the insulators and insulator-hardware combinations needed for EHV transmission.

Constant use of these research facilities has shown us, and our customers, how to apply O-B materials at extra-high voltages. That research also assures you that the same materials are the best available for use at *any* voltage in your system.

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass



Sometimes hardware doesn't Corrode fast enough!

Inside this chamber (usually tightly sealed), insulators and hardware soak continuously in a corrosive atmosphere—a rich blend of sulphur dioxide, humidity, and heat. In this noxious air, corrosion takes place at a great rate, and that's exactly the desired result!

Or rather, that's the needed result. Left to nature, hardware doesn't corrode fast enough for practical study. Accelerated corrosion allows Ohio Brass engineers to study corrosion and its effect on hardware without waiting on nature. They ask: What inhibits corrosion under the conditions in which insulators and hardware are used? What promotes it? What does it have to do with radio interference characteristics? What are some workable, immediate remedies for corrosion troubles, and what long-range work can be done to forestall trouble in the future?

Systematic study of corrosion on transmission and distribution hardware, and on insulators, has turned up worthwhile information for our designers, and for immediate benefit for users of these materials. (Recent findings are found in AIEE Transactions Paper, No. 56-230. Write to us for a copy.)

Solutions to problems of corrosion are important—but just as important, we feel, is O-B's willingness to devote the time and energy of a talented technical group, and a considerable amount of money as well, to research that may or may not turn up commercially worthwhile results. That willingness is a chief part of the Ohio Brass Technical Competence concept. You'll find it in evidence throughout the O-B organization!

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

Meet the New Hired Man!

Total farm population has dropped nearly 25 per cent in the past 15 years. Yet farm productivity has increased steadily. One farm worker now produces enough food for himself plus 18 others. Two million of our farmers produce 88 per cent of our farm products.

This increased productivity is possible because electrical servants and mechanical helpers have replaced the hired man on many farms. These electrical servants work a lot cheaper and they don't have to be fed. They milk the cows, cool and handle the milk; cool or heat the pigs, depending on the season; keep the chickens happy with water, feed and comfortable temperatures.

This is only the beginning. Most experts say the average farmer will be using as much as 30,000 kw-hr in ten years, more than ten times as much as he uses today.

Graybar can help you get ready for the increased rural load that's sure to come. Let Graybar serve as your warehouse. With Graybar serving you, O-B distribution materials will be ready when you need them. Then your customers can put more electrical hired men to work.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

4670-H

Plant Fire Plan Saves Utility's 30-Yr Record

D. E. WOODS, Insurance Director, Central Power & Light Co, Corpus Christi, Texas.

A long-established fire-fighting program twice saved Central Power & Light Co's 30-year record of no major fires at company stations. Prompt and effective action by indoctrinated personnel preserved that record, and the program which made such action possible is continued today.

Obsolete Equipment Replaced

Fire control and extinguishing equipment in the company's power plants is of practically every type of extinguisher and extinguishing agent in common use over the past 20 years. Although many old extinguishers are as effective today as when they were purchased, they are being replaced with newer, more efficient equipment. As soda acid, foamite, pump type carbontetrachloride, and similar extinguishers become obsolete, they are replaced by more modern equipment. Meanwhile, before being junked, they serve in low-hazard areas.

2. Hoses Always Ready

All power plants today have dry chemical extinguishers. In open areas of slight hazard, some pressurized carbontetrachloride extinguishers remain. Each plant has a sufficient number of hose lines equipped with nozzles to reach any area containing combustibles with two hose streams.

Monitor Big Help

At plants having fire pumps, the hose carts have a "monitor," permitting one man to handle a 2½-in. nozzle on full fog, or to direct a solid stream as high as the top of a cooling tower. Such carts enable one man to lay up to 350 ft of hose from hose house racks.

The "monitor" consists of an oil field joint, nipples, a 45-deg ell, and a ball-bearing female hose coupling. It is attached to the tongue of the cart so that the downward thrust of flowing water holds the end of the tongue against the ground while the nozzle

(*Continued on page* 178)

If you buy distribution transformers

HERE ARE FIVE THINGS YOU SHOULD KNOW

1. Who is RT&E?

A 10 year old manufacturer of distribution transformers, located in Waukesha, Wisconsin. Its personnel have hundreds of years of experience in designing, building and servicing the finest distribution transformers.

2. How big is RT&E?

Not as big as the giants, yet very big in ability, in performance, in engineering and in service. Small enough to value every customer, big enough to service the entire nation.

3. What does RT&E make?

Distribution Transformers in all styles from 3 thru 500 KVA.

4. Are RT&E Transformers different?

Yes, RT&E has pioneered most of the new features of the last 10 years, such as the *Externally Operated Tap Changer, Wick-fed Oil filled Bushing, Balanced Construction Wound-Core* and the *Spiral-Groove Lightning Arrester.*

5. Are RT&E Transformers dependable?

Yes, RT&E is the manufacturer that initiated the FIVE year Guarantee as proof of dependability.

To get the best buy for your company, send for complete details on RT&E's outstanding products.

RT&E CORPORATION
WAUKESHA WISCONSIN

Cope Cable Trough at Kansas City Power & Light Company's Hawthorn Station.

Kansas City Power & Light Adopts Cope Cable Trough

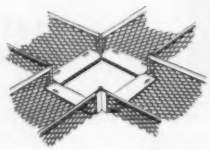
Kansas City Power & Light Company engineers installed versatile Cope Expanded Metal Cable Trough for cable supports in the modern Hawthorn Station. Forward looking engineers in utilities and industry everywhere are building modern distribution systems with Cope Cable Trough.

When you specify an Expanded Metal Cable Trough System you **save materials.** Cope Trough and Rakit Supports provide only the material you need and give you the **lowest installed cost of any cable supporting system.**

Engineers everywhere are specifying Cope Expanded Metal Cable Trough because it:

Saves Materials • Saves Space • Simplifies Maintenance and Inspection
Permits Higher Cable Current Ratings **Improves Flexibility**

New Cope 70,000 Series features exclusive Pin-Type Coupler that greatly reduces installation time.



C-605

Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

T. J. COPE, INC.
COLLEGEVILLE 4, PENNSYLVANIA

Cope

GROUND TENTS

ROD GRAPPLES

CABLE REEL JACKS

PNEUMATIC FISHLINE

Plant Fire Plan

(*Continued from page* 175)

swings through a vertical arc of about 210 deg or through a full 360 deg of horizontal arc.

Besides extinguishers or hose lines, areas difficult to reach in older plants have water spray systems. These are manually controlled by valves remote from the hazardous areas.

Fixed Spray Nozzles Used

One plant has a switchgear room which is inaccessible. Its various switch compartments have been piped for flooding with carbon dioxide by means of manually operated valves in event of a ruptured oil switch. The relatively small oil circuit breakers are in self-contained cells having curbs for retaining the oil in the switch compartments.

All newer plants are relatively open on the condenser floor area. Oil tanks in vaults or in open and other hazardous places are covered with fixed spray nozzles controlled by remote manual valves. Automatic control of water spray was considered originally, but rejected after an analysis of costs and because of the possibility of being accidently operated or of failure to operate when needed.

Employees Trained

Through a recently initiated training program, most employees are familiarized with the use of fire extinguishing equipment in ordinary circumstances. They are taught about the hazards of being caught in a non-exit area when a flash fire could spread into a major conflagration. A fire in a 138-kv transformer, like any fire well advanced, requires use of a 150-lb dry chemical unit. Water fog, either low or high pressure, is used where oil has spilled outside the drain pits or when the fire is beyond the capacity of the chemical equipment.

How to Fight Gas Fires

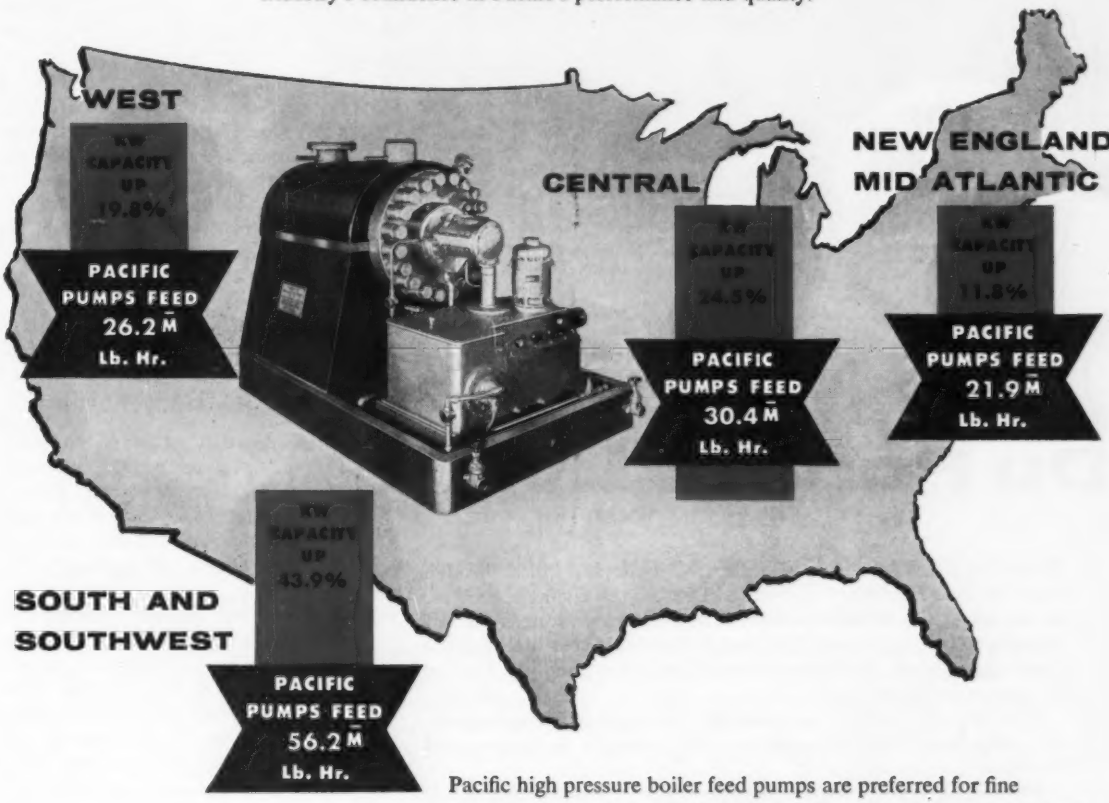
Particular emphasis is placed on action to be taken in the event of a gas fire. When a gas feeder line for boiler burners ruptures and ignites, the fire must not be attacked directly. Instead water spray is used to cool the upper flame area while the gas supply is tripped from the control room or from the main outside valve which is closed manually.

A man transferred from one plant

(*Continued on page* 178)

Keeping up with the kilowatts

From 1951 to 1955 the capacity of Pacific high pressure boiler feed pumps installed in each of the four regional areas of the U. S. has kept pace with the increase in electrical generating capacity in each area. This universal acceptance and repeat orders from individual Utilities in each area for 12-15 units express the Industry's confidence in Pacific's performance and quality.


WEST
KW CAPACITY UP 19.8%
PACIFIC PUMPS FEED 26.2 M Lb. Hr.
CENTRAL
KW CAPACITY UP 24.5%
PACIFIC PUMPS FEED 30.4 M Lb. Hr.
NEW ENGLAND-MID ATLANTIC
KW CAPACITY UP 11.8%
PACIFIC PUMPS FEED 21.9 M Lb. Hr.
SOUTH AND SOUTHWEST
KW CAPACITY UP 43.9%
PACIFIC PUMPS FEED 56.2 M Lb. Hr.

Pacific high pressure boiler feed pumps are preferred for fine new power plants everywhere. They follow the load perfectly from 100% down to trip off. They are efficient—economical to operate and maintain.

PACIFIC PUMPS INC.
HUNTINGTON PARK, CALIFORNIA
Offices in All Principal cities
Export Office: Chanin Bldg., 122 E. 42nd St., New York

PACIFIC®

BF-22

Just one application of "Telvar" controlled weeds around this fence. Note the type of vegetation involved in untreated area in the foreground.

Spray just once with Du Pont TELVAR®

WEED KILLERS

When you use "Telvar" weed killers, vegetation is killed through the roots, and regrowth is prevented because the chemical remains in the soil . . . provides residual action all season long. And low dosages (1 to 1½ lbs. per 1,000 sq. ft.) make it cost little for the results you obtain. Such low rates also mean less handling, less use of storage facilities.

"Telvar" weed killers come as wettable powders, are non-corrosive, non-flammable, non-volatile, low in toxicity to humans and livestock.

Include "Telvar" weed killers in your weed-control program this year. Prove to yourself how these products of Du Pont research can help cut your maintenance cost to new low levels.

Where brush is a problem, Du Pont Ammate® X weed and brush killer is the product you need. It kills more kinds of brush with unusual safety. With ordinary precautions, "Ammate" X may be used close to such crops as cotton, tomatoes, soybeans and peanuts.

• • •

FREE ILLUSTRATED BOOKLETS describe how to control weeds and brush with Du Pont chemicals. Write to Du Pont, Grasselli Chemicals Dept., Rm. D-4032, Wilmington, Del. In Canada, Du Pont Company of Canada Limited, 80 Richmond Street West, Toronto, Canada.

DU PONT
REG. U. S. PAT. OFF.

On all chemicals, follow label instructions and warnings carefully.

WEED and BRUSH KILLERS

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Plant Fire Plan

(*Continued from page* 176)

the differences between the plants, especially with regard to the location and particular functioning of disconnects.

Each plant has its brigade chief who reports to the plant's chief engineer and is responsible for checking all fire-fighting equipment at least once a month. Employees, according to shift position, are assigned specific fire duties, and one is appointed to handle calls to the fire department. There are particular instructions for most personnel on when to abandon stations to attack the fire.

Each power plant chief and division engineer is fully responsible for fire prevention and extinction in his plant or substation. In the home office, the chief engineer, superintendent of power stations, assistant structural engineer, and insurance director are available to assist them.

Niagara Mohawk Holds Industrial Heat Forum

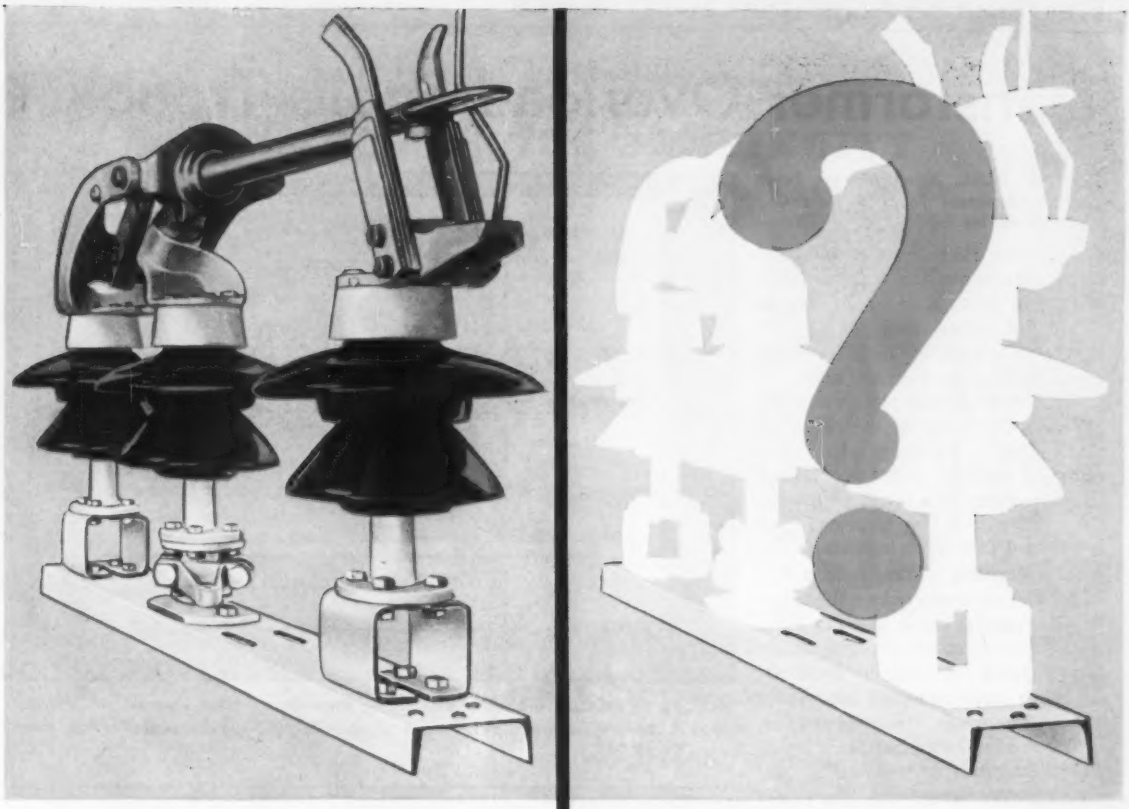
An industrial forum on high-temperature electric heating, conducted recently by Niagara Mohawk Power Corp, brought together representatives of industrial plants from within a radius of 90 miles of Buffalo, N. Y., reports W. P. Ackendorf, power sales representative, Western Division.

Topics covered by two experts at the weekly meetings included modern trends in electric furnaces and in induction heating, salt bath furnaces, arc furnaces for use in foundries and steel works, 60-cycle induction heating of ferrous metals, continuous tube welding with high frequency resistance heating, heat treating steel with induction equipment, high power industrial dielectric heating, surface hardening by induction heating, and automatic temperature control modes.

Interest was reported keen in current and coming manufacturing techniques, processes and equipment involving temperatures above 1,000 F.

William B. Campbell, power sales supervisor in Buffalo, Ackendorf, and Byron F. Lyth, power sales representative, acted as chairmen during the forum sessions.

(*More Industrial on page* 180)



Original or 'similar'— which do you prefer?

Delta-Star MK-40 Switches feature maximum contact efficiency and safety, with minimum current interchange surfaces.

Blade mechanism of MK-40 Switches has only three moving parts, yet develops enormous rotating operating leverage.

When you consider high voltage switches, one stands out because of its original performance-proved features that seem to be appearing in other switches. The standout is Delta-Star's MK-40.

Appearance to the contrary, *Delta-Star MK-40 Switches alone offer a combination of unequalled advantages originated by Delta-Star.* They feature sturdiest possible construction and large, rugged sealed-type ball bearing blade actuating mechanism for assured long service. They have a minimum number of moving parts and minimum current interchange surfaces—for efficiency and ease of operation. Contact pressure-applying springs carry no current, and offer large deflection to maintain uniform high pressure contact over extended periods of use. The fully controlled blade makes high pressure silver-to-copper contacts at both ends. Contacts are fully visible for inspection.

Similarities help prove the exceptional value of the original. That certainly applies to Delta-Star MK-40 Switches—in all ratings—400 to 5000 amperes and 7.5 to 380 kv. Keep the MK-40 as your standard of comparison.

DELTA-STAR ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.

2437 Fulton Street • Chicago 12, Illinois

District Offices in Principal Cities

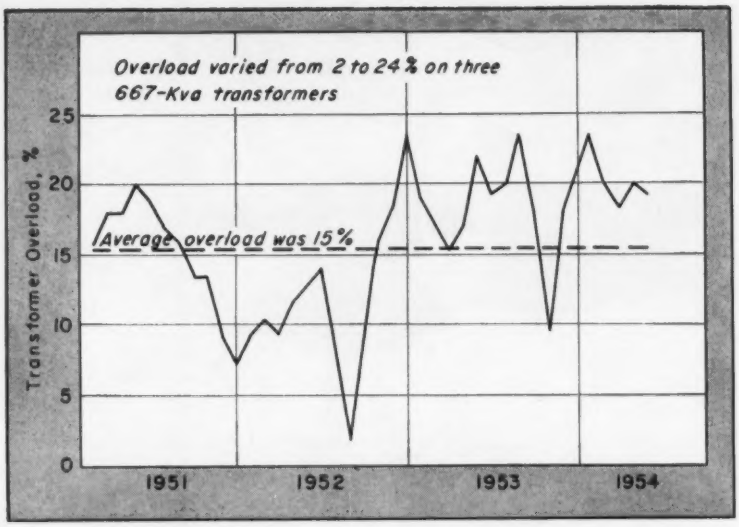
Transformer Overload Spells Trouble

JAMES C. AULL, Acting Director, Power Sales, Indianapolis Power & Light Co., Indianapolis, Ind.

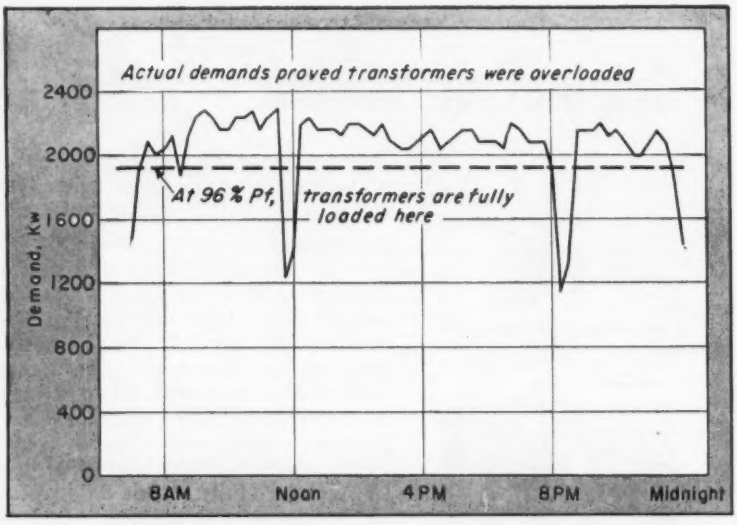
American Foundry Co, Inc., Indianapolis, wanted to install electric heaters in tanks used to impregnate automotive engine block castings, but the plant's 2,000-kva transformer bank could not take the proposed load.

When their present plant was built, the diversity factor of the old plant was applied to the design of the new electrical system. A 2,000-kva bank of transformers was installed to serve the entire plant. This bank had been overloaded 15% since installation, the overload existing about 16 hr a day. This overload could reduce the transformers' normal life as much as 10%.

Until more transformer capacity was provided, the company could not capitalize upon new and better productive equipment, it was pointed out. Equally serious, the plant faced a possible transformer failure which would cut back operations 50%—if not shut down the plant entirely—while repairs were made. And due to the relative scarcity of spare 667-kva transformers, a shutdown could mean days.



ACTUAL OVERLOAD probably was worse than shown here because pf at peak load is likely to be less than average pf. Average pf was the basis for this chart



ACTUAL DEMANDS on a quarter-hour integrated basis were logged for graphing to illustrate the power demand picture for the foundry's typical 2-shift day

Low Voltage Caused Trouble

In making a report to the company, the utility showed with the accompanying charts how overload on the transformer bank had persisted. The utility also pointed out that, because of the overloaded transformers, the company was afflicted with low voltage throughout its plant. This tended to cause motor overheating and lower lighting output.

Changing tap settings on the bank could have compensated for low voltage. But this was not desirable because it would cause high voltage at night and on week ends, shortening lamp life and threatening capacitor installations. Furthermore, it was pointed out that transformer overloading caused, in turn, transformer overheating. In hot weather, these excessive temperatures are aggravated by summer heat and also by the partially enclosed nature of the transformer location.

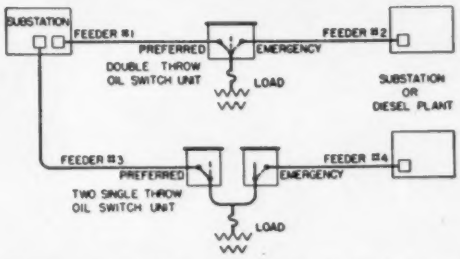
It was recommended, therefore, that this bank neither be increased in capacity nor replaced with a larger bank at that location. Instead it was recommended that:

- A 1,000-kva transformer bank be installed immediately at the foundry's Core Building.
- A 1,000-kva bank be installed later at the Cleaning Building.
- A future installation should be considered for possible installation at the Maintenance Shop.

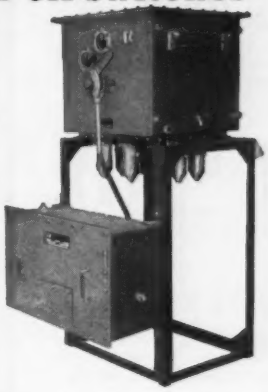
The foundry's management already has acted upon these recommendations by installing the first unit substation at the Core Building. It is a 1,000-kva, 3-phase 4,160/480-v unit.

INSURE SERVICE CONTINUITY

with G&W Automatic transfer oil switches

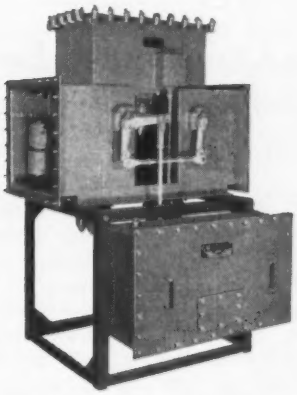


- When preferred feeder voltage fails, the load is automatically transferred to the emergency feeder.
- When preferred feeder voltage is restored (for a period of ¾ minute) the load is automatically returned to the preferred feeder.
- There is no "hunting" on system disturbances. Load cannot be thrown to a "dead" source.
- Model "F6" automatic mechanism provides for remote operator selection of either feeder as the "preferred."

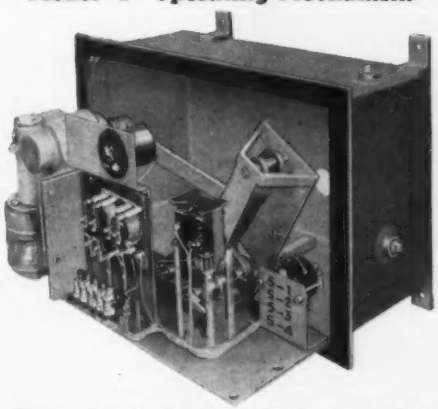


Type "RAD" double throw oil switch unit with Model "F" automatic mechanism.

Model "F" Operating Mechanism



TYPE "DRA" two single throw oil switch unit with Model "F" automatic mechanism. Air filled isolating link box on top.



Improved mechanism removable from watertight case. Motor compresses spring which, when released through action of relays and solenoid, operates the oil switch.

The automatic mechanisms are applied to various forms of Type "RA" oil switches, either for underground cables or overhead connections—up to 23 Kv., 400 amperes. All control wiring is done at the factory. Installation of the unit merely involves connection of the feed and load cables or wires.

Send for Bulletin DA-F which fully describes Model "F" mechanism.

G&W ELECTRIC SPECIALTY CO.

7780 Dante Avenue, Chicago 19, Illinois, U.S.A.

Representatives in principal cities of U.S.A.
In Canada—Powerlite Devices, Ltd., Toronto, Montreal & Vancouver

G&W

D561

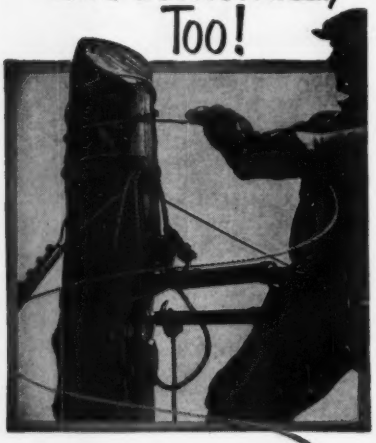
Crapo
GALVANIZED STEEL
STRAND

Strong...
to support pole structures under adverse ice and wind loadings.

Rugged...
to withstand the punishment incurred in construction and service.

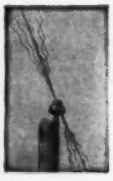
Long-Life...
provided by famous Crapo Galvanized heavy, ductile, tightly-bonded zinc coatings.

and Economical, Too!



● Each size and grade of time-proved Crapo Steel Strand utilizes the superior tensile strength of steel to the fullest advantage. Next time, specify Crapo Steel Strand for guy, messenger and overhead ground wires . . . and *save on maintenance!*

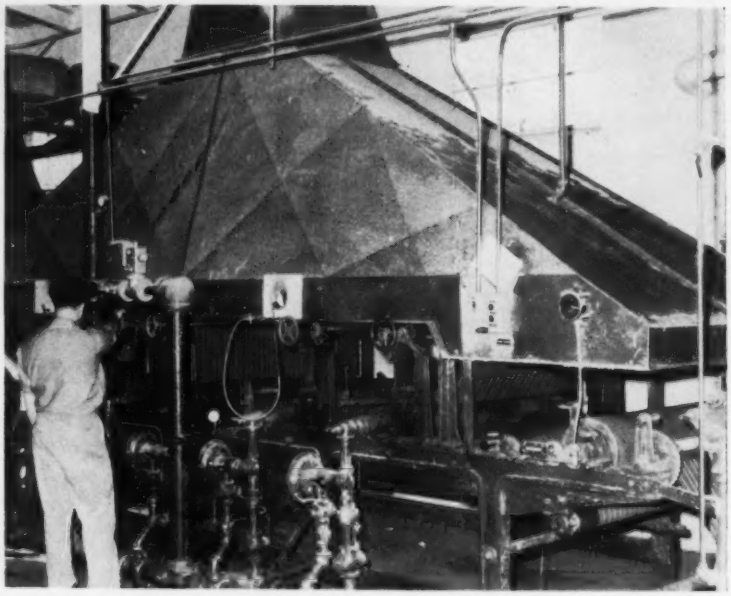
REINFORCE and PROTECT YOUR CONDUCTORS with Preformed ARMOR RODS



Minimize wear and chafing . . . Absorb and dissipate vibration . . . Protect against arcing and flash-overs . . . Increase holding power against slippage . . . Lessen possibilities of corrosion . . . *Reduce overall maintenance costs.*

Contact your jobber of Crapo Galvanized Products or write direct for further information!

INDIANA
STEEL & WIRE COMPANY
MUNCIE, INDIANA



BIG HOOD COVERS singeing machine to catch burned lint and bad odors generated when fabric passes over open flame burners at speed of 200 yd/min

Fan Yields Twin Operational Benefits:

. . . It keeps working conditions pleasant by expelling odors and helps maintain safety by sucking out singed lint filaments

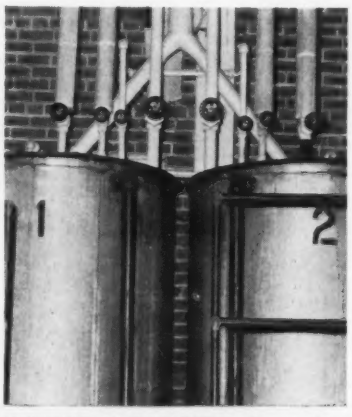
LEON ALBERTSON, Market Studies & Service Div., Philadelphia Electric Co, Philadelphia, Pa.

Installation of a 1½-hp exhaust fan on a new singeing machine in the plant of Cold Spring Bleachery, Yardley, Pa., is yielding two important operational advantages: The fan removes smoke, fumes, and odors to keep working conditions pleasant, and it promotes safety by drawing off ignited lint.

The 36-in. fan carries off airborne residue from the singeing process in which fabric is brought into contact with six open flame gas burners at the rate of about 200 yards a minute.

The installation was carefully engineered to achieve high efficiency, and a 10,000-cfm fan with adjustable pitch propeller was selected. Mounted on the roof, the fan draws air impurities from a 5½ x 20-ft hood over the singeing machine, through a 3 x 3-ft duct, and expels them outdoors.

Another small fan also is doing a big job. This 6¾-in. centrifugal 1/10-hp fan pulls vapors from two 300-gal solution tanks through an inverted "Y" of 3-in. ductwork over them. The 1,750-rpm, 100-cfm fan helps check corrosion and rusting of adjacent pipes and metal. The tanks contain an enzyme heated by steam coils to 160F for supply to a fabric bath in the singeing machine.



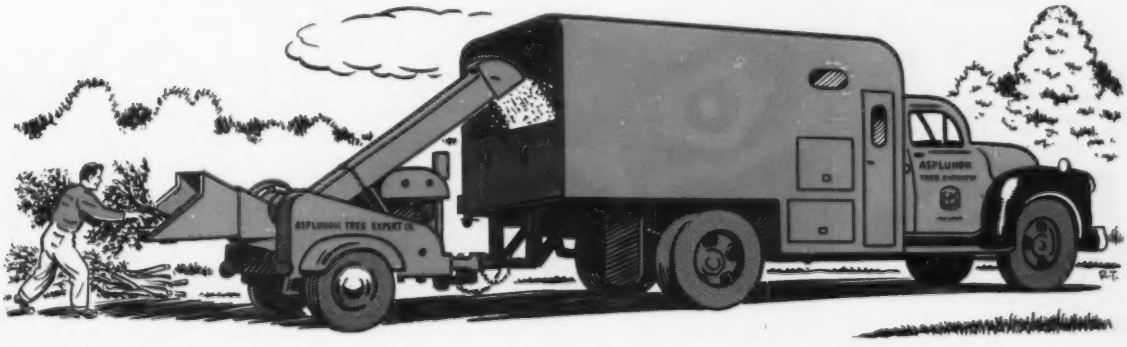
MOISTURE IS EXHAUSTED from these two tanks to prevent metal corrosion

NATION-WIDE SERVICE

Asplundhs work *exclusively* for the Public Utilities of America.

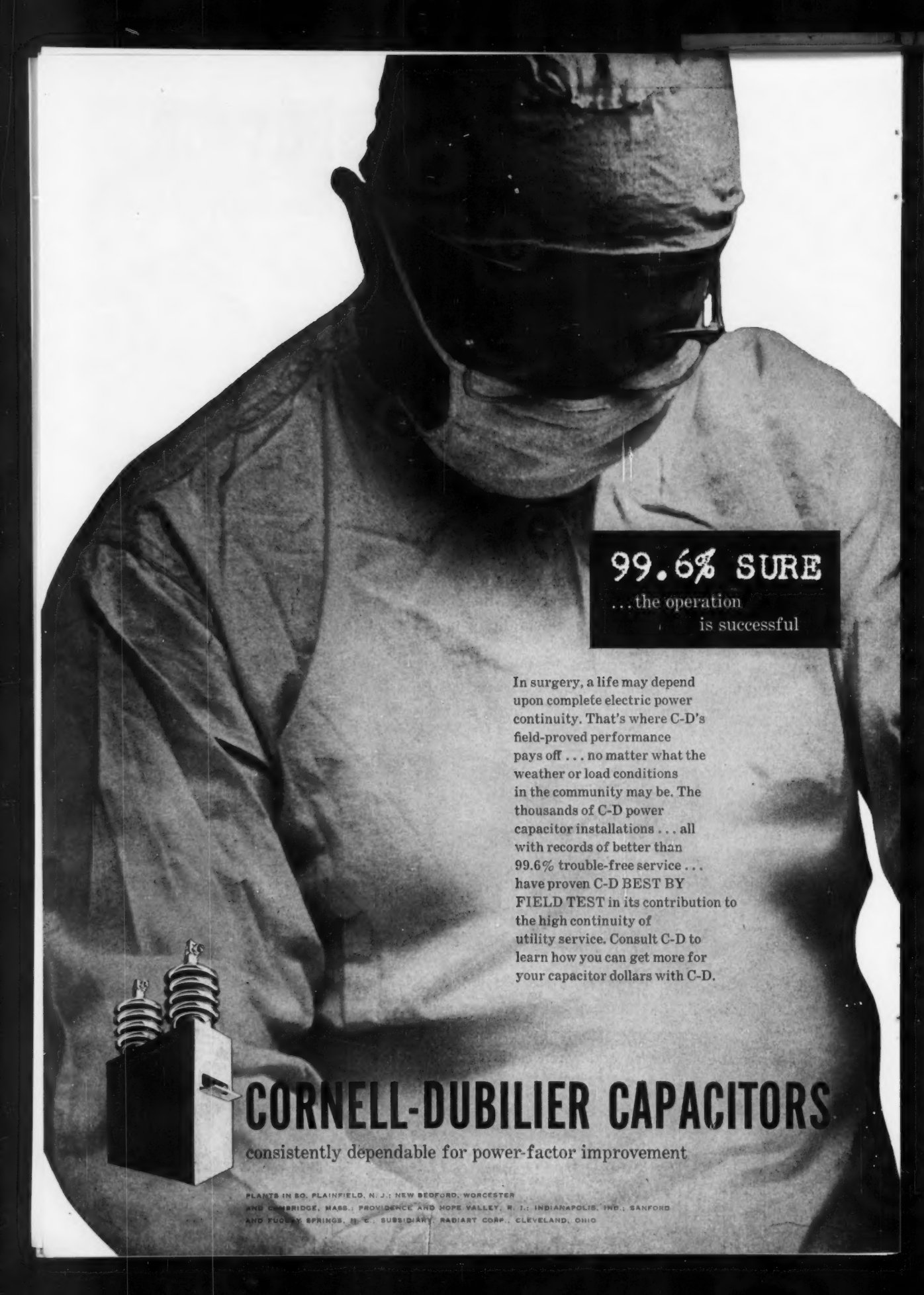
Our line clearance and right-of-way operations are not a side line but a highly specialized business which enables our clients to provide better service, enjoy finer public relations, and save substantially on all of their tree work.

This specialization applies to our trained personnel, superior supervision, modern equipment, complete insurance coverage, safe operation, strategically located service centers, and sound administration policies. We'd like to talk it over with you!



Write for your copy of our new EMERGENCY FOLDER, with day and night listings of Asplundh men to call when a storm makes special, fast tree work imperative.

ASPLUNDH TREE EXPERT CO.
Jenkintown, Pa. and principal cities


99.6% SURE
...the operation
is successful
In surgery, a life may depend upon complete electric power continuity. That's where C-D's field-proved performance pays off . . . no matter what the weather or load conditions in the community may be. The thousands of C-D power capacitor installations . . . all with records of better than 99.6% trouble-free service . . . have proven C-D BEST BY FIELD TEST in its contribution to the high continuity of utility service. Consult C-D to learn how you can get more for your capacitor dollars with C-D.
CORNELL-DUBILIER CAPACITORS
consistently dependable for power-factor improvement
PLANTS IN SO. PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY, RADIART CORP., CLEVELAND, OHIO

CORNELL-DUBILIER power-factor capacitors give you better than 99.6% trouble-free service*

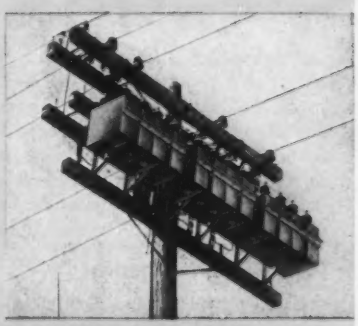
Low dielectric unit stress provides an extra margin of safety that results in the ability to withstand higher transient voltages. When you buy C-D, you buy premium quality at no extra cost.

C-D capacitors are impregnated and filled, in hermetically sealed containers with non-inflammable, non-explosive Dykanol. In addition, C-D's conservative engineering and design makes possible the use of special impregnants to fulfill even the most exacting requirements for sub-zero switching operations.

Extra strength wet process two piece porcelain terminals . . . one of the many important reasons why C-D capacitors can point to year after year of trouble-free service in coastal areas.

Another evidence of C-D's premium quality power capacitor service . . . at no extra cost . . . is the fact that C-D has *no* "Return Material Department". Most repairs are of such a minor nature that they are handled on an individual basis. This results in a prompt, personalized service impossible where the safety factor has been cut in favor of production, weight and size economies.

Why is it that only C-D power capacitors give you assurance of complete dependability?... because C-D's built-in safety factor results from the ultimate in tried and proven design levels coupled with conservative production techniques and rigorous quality control. For catalog write to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.



This pole-mounted C-D Capacitor installation has been on the job for an Eastern utility since 1939 with little or no maintenance.

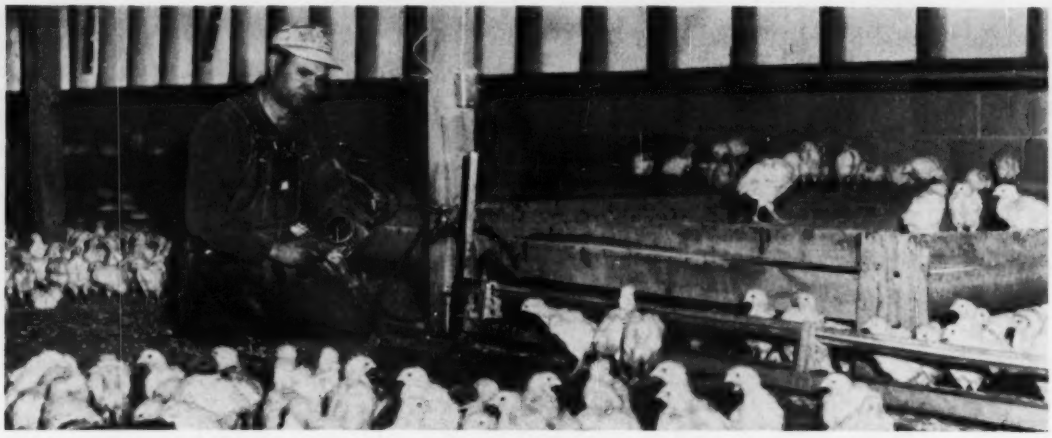
*This is an average based on reports from leading utilities using C-D capacitors. Many of these reports have shown 100% trouble-free service, and none lower than 98.9%.

INDUSTRIAL BRIEFS

Calibrating truck thermostats accurately is now assured at Power Brakes Inc, St. Louis, through use of controlled electric heat. These truck thermostats are of the bellows type. They operate air cylinders which open and close shutters placed in front of the truck radiator to control engine temperature. Five hundred watts of thermostatically controlled immersion heat maintains the desired temperatures in the calibration and test tanks for these thermostats. These temperatures are in the range of 160F to 190F. Expanded test facilities will now include electric heat as an integral part of the test equipment. George C. Wagner, Industrial Engineer, Union Electric Co of Missouri. St. Louis.

One-day washing and pressing service on shirts has been established by the "Maytag Wash Tub" of Kansas City, a launderette. The new service was offered because the launderette was looking for new sources of revenue. Electrically heated pressing equipment was installed because there was no other requirement for steam. The equipment consists of a collar and cuff press, sleeve press, body press and folder. This equipment, set up in the front window, drew so much business that a second set of the above equipment, plus an additional collar and cuff press and a uniform press were installed. They now have a total of 23,350w in electric pressing equipment, the first installed in a launderette in Kansas City. A. T. Gaulke, Industrial Engineer, Kansas City Power & Light Co, Kansas City, Mo.

Vapor degreasing automotive parts is done in a 4 x 4 x 6-ft tank at Theobald Automotive Co, Baltimore, Md. Containing 15 to 20 gal of trichloroethylene solution, the tank is raised by 22½ kw of strip heaters on the tank bottom to a 150F working temperature in the vapor. From a cold start, heating requires only 10 to 12 min. This fast heating obviates "idling temperatures" and contributes to operating economy and flexibility. Parts are lowered into the vapor zone where the vapor condenses on the cold metal, and runs off, carrying the dirt with it.—C. G. Feeser, Industrial Representative, Baltimore Gas & Electric Co, Baltimore, Md.



With Radiant Under-Floor Brooders like this, Alabama Power finds . . .

How to Make $225,000 from Scratch

Chicks are healthier, safer for only ¾¢ each; farmers are happier with low cost, top results; utility promotes 300 jobs in just 2 years.

WALTER L. BAKER, JR, Agricultural Engineer, Alabama Power Co, Birmingham, Ala.

Active promotion of radiant under-floor brooders reaps Alabama Power Co $225,000 yearly by selling farmers on benefits of electric heat.

Over 300 brooders (450 kw) have been added to the lines during the past two years as a result of promotional efforts that include individual help, success story publicity, tours, and displays.

Started with Engineer

Promotion of radiant under-floor brooding stems from the efforts of John Bryan, rural service engineer, who installed the state's first unit in November, 1953. Built for 1,000 chicks, the brooder has six 8 x 10-ft concrete slabs, each heated with 1.6 kw of electric cable placed 1½ in. below the top surface. Forming the base is 4 in. of crushed rock and gravel covered with a 15-lb felt paper and 2½ in. of insulating material.

After six weeks of operation the brooders were turned off and the meter read. It was found that the cost of energy averaged only 1.07¢ per chick, including lighting and water pumping. The job had come up to all expectations.

During December, 1953 two other small brooders, which provide 11½ sq in. of hover space per chick, went into operation. Both produced equally good or better results. No sickness was noticed in any of the flocks. And broilers feathered out well and gained weight rapidly. Also flameless electric heating eliminated any chance of fire hazard. For this reason and because moisture is not liberated, it is easier to maintain a dry litter. Droppings which accumulate on the slab dry rapidly and are easily removed with a broom.

The brooder is fully automatic. Its operation is controlled by a thermostat which holds the temperature within two degrees of the setting. There are no hot or cold spots, because of uniformly spaced cable. About seven hours are required for a slab to lose five degrees if service is interrupted.

Sales Program Launched

Based on this experience, Alabama Power pushed an intensive radiant under-floor brooder sales program. Complete instructions were prepared in booklet form and mailed to all poultrymen within the service area. Success stories of installations were released to selected newspapers and farm journals. Other stories were prepared for trade magazines subscribed to by Alabama poultrymen.

An installation was placed in operation in one of the state agricultural experiment stations. Tours were arranged with interested poultrymen to see brooders already in operation. Rural service engineers offered their assistance.

Year-round Cost Under ¾¢

By the end of the first year 128 brooders with a capacity of 135,500 chicks and a connected load of 186 kw were installed. Year-round brooding costs were found to average less than ¾¢ a chick.

The company continued its promotional efforts and established a plan for financing radiant under-floor brooders at a low interest rate. Cut-a-way models of the brooders were developed for display at county fairs and in company show windows.

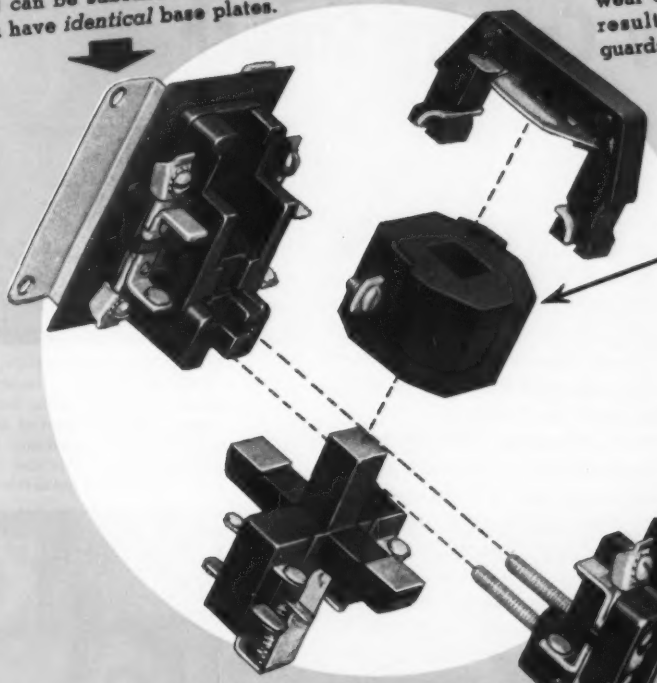
As a result the second year (1955) has been even more outstanding. Alabama now has about 400 slab installations providing brooding capacity for more than a million chicks a year. The broiler industry is still growing, and Alabama Power is building a great new source of rural revenues.

(*More S & S on page* 190)

this new, small size SQUARE D RELAY has features you'll like!

NO MOUNTING WORRIES
When more contacts are required, the 4-pole relay (DO-42) can be substituted for the 2-pole (DO-22). Both have *identical* base plates.

OUTSTANDING PERFORMANCE
Balanced construction reduces wear on single moving part... results in long life and safeguards against down time.



RESISTS DAMAGE
Plastic impregnated molded coil is unbreakable, operates cooler, is dimensionally stable and impenetrable by water and oil.

20-SECOND DISASSEMBLY
Simply loosen two screws and the entire device is disassembled for normal maintenance.

This new **Class 8501 Type D relay** is amazingly compact. 2-pole version measures only 3 1/16" high x 2 5/8" wide! 4-pole is only 3 11/16" high x 2 13/16" wide! Both rated 10 amperes, 600 volts. Packaged parts kits make normal maintenance easier than ever. Write for Bulletin 8501 which tells the complete story. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin.

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

How Rome Synthinol® Control Cables serve Philadelphia Electric at its New Cromby Station

Philadelphia Electric Company, privately owned and an important producer of electrical power, has recently completed its eighth large generating station—Cromby.

The Cromby Station will increase the capacity of Philadelphia Electric's system by 17% to keep pace with booming industrial and residential development of the Delaware Valley.

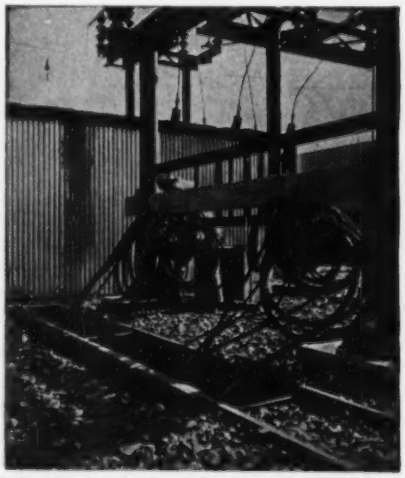
Cromby is a two-unit station. Already in operation is a 150 megawatt steam generator and an additional 200 megawatt unit will be operating by mid-1956.

Over 1,500,000 conductor feet of Rome Synthinol Control Cables were used at Cromby. There are two major applications . . . remote control of high-voltage yard circuits and regulation of the soot blowers. Underground cables for yard control are insulated with Rome Synthinol, rated at 60°C.

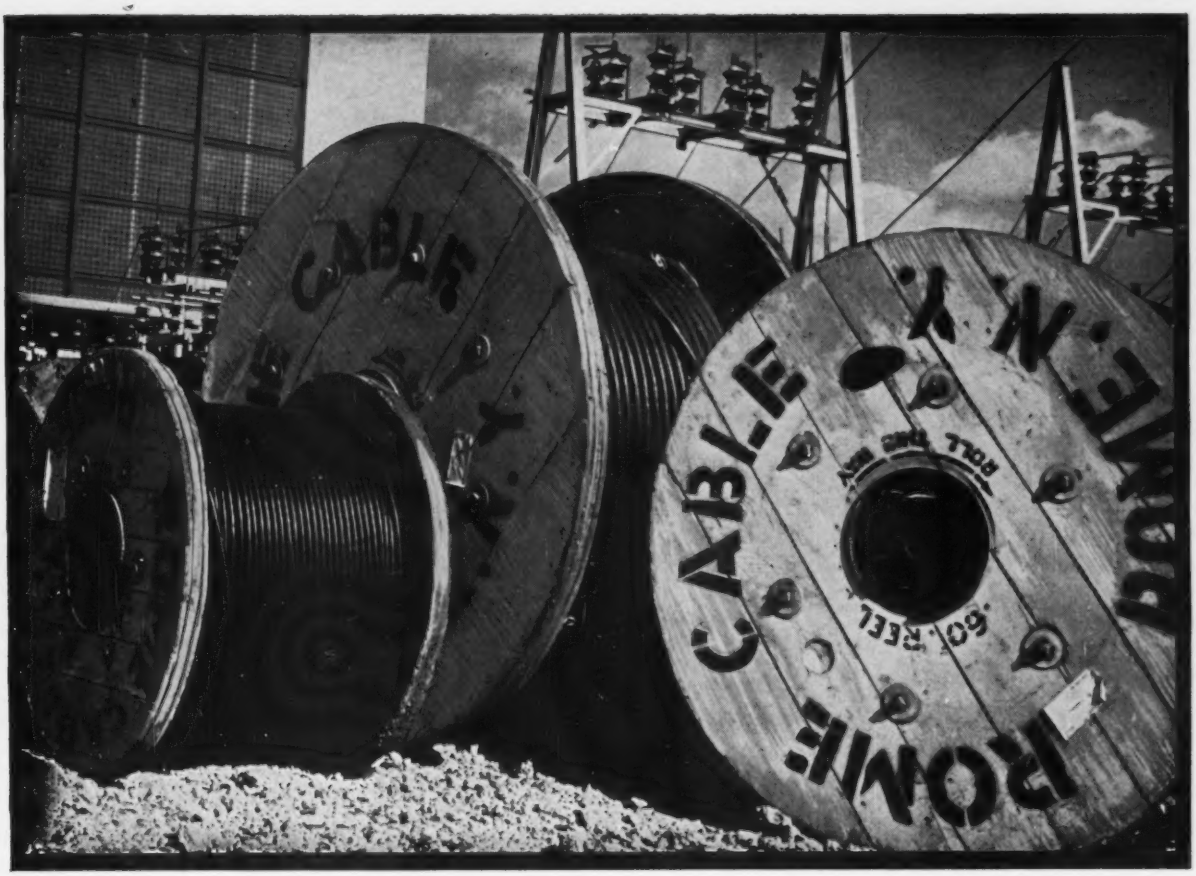
You, too, can specify Rome Synthinol Control Cables with confidence.

The Cromby story is continued in the picture captions . . .

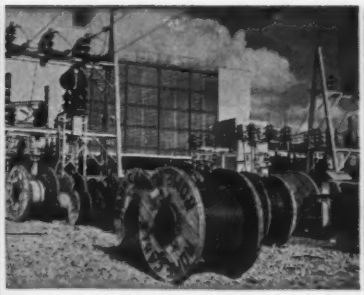
The development of cables, having multiple conductors under a common nonmetallic sheath, in which Rome has played an important role, has been of inestimable value in station control planning. Not only do they save installation time and costs but provide good mechanical protection, as well.



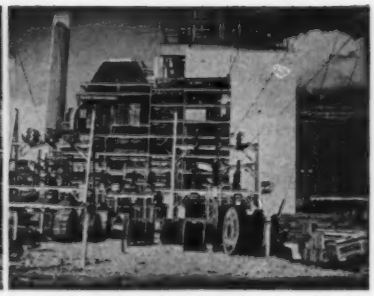
The fundamental application of Rome's product is in control of the 33,000, 66,000 and 132,000 volt yards. There the Rome Synthinol (polyvinyl chloride) insulated and sheathed cable is buried directly in earth.



Every factor was weighed carefully before specifying polyvinyl chloride for underground work. Its qualifications fitted two very important requirements at Cromby . . . high resistance to moisture and good dielectric strength.



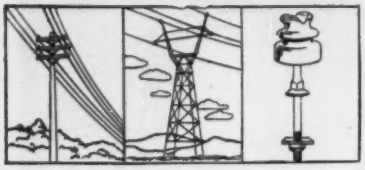
The Rome underground cable at Cromby is expected to last a good many years. Its superior resistance to soil conditions assures long, trouble-free service life.



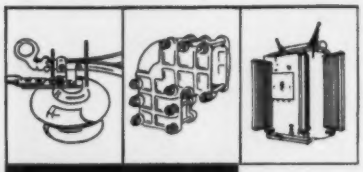
Installation experience under a wide variety of service conditions has proved polyvinyl chloride insulation and sheath to be extremely dependable—more economical than some other constructions.

It Costs Less to Buy the Best

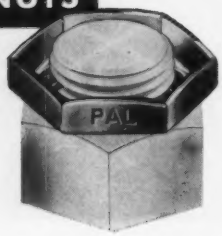
ROME CABLE Corporation
ROME · NEW YORK
and
TORRANCE · CALIFORNIA



Keep Nuts Tight
on all bolted assemblies



Apply
PALNUT
LOCK NUTS



PALNUT Lock Nuts apply so fast, lock so dependably . . . you can specify them for every nut-and-bolt assembly, at negligible cost. Maintenance is reduced on mechanical assemblies — full conductivity assured on electrical connections.

PALNUT Lock Nuts may be used on new or existing equipment. Easily removed and re-used when servicing. Require only 3 bolt threads. Available in Parkerized and hot dip galvanized steel; also silicon bronze.

Send for free samples and Bulletin #577

THE PALNUT COMPANY
51 Glen Road, Mountainside, N. J.

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

LILCO Gets 'Success by Selectivity'

LIVE BETTER ELECTRICALLY

Long Island uses rifle, not shotgun, for cooling prospects, trade meetings

Long Island Lighting Co's Live Better . . . Electrically program is keyed to what might be labeled "Success through selectivity."

Demonstrated by a recent air conditioning "Coolerama" and a forthcoming series of meetings with trade allies, Long Island is firing at LBE goals with a rifle, not a shotgun. William J. Schmidt, assistant vice president of electric sales, is the man who picks the targets and tells when to fire.

Invites Special Prospects

In the "Coolerama" show held last month, Long Island laid the groundwork, then teamed with 17 manufacturers to lure 8,000 potential cooling customers to the Hempstead, L. I., Armory. These were special prospects, though, who'd received personal invitations (professional people—doctors, dentists, lawyers and bankers—beauty parlor operators and barbers, architects), all logical targets for initial air conditioning sales.

The homemaker wasn't shunned. An introductory press luncheon and radio broadcasts got the air conditioning story, with LBE embellishments, started. Nightly broadcasts from the Armory featured interviews with cooling experts and visitors.

Did the selective audience pay? It's early to tell, sales-wise, but the manufacturers with displays voiced unanimous enthusiasm over the large attendance.

Next on the Long Island schedule will be five local-level meetings with trade allies in two small but densely populated counties of New York's promontory. The sessions will be individualized to cope with local needs, problems, and potential. They'll include kinescope showings of the Feb. 8 LBE telecast and "Meet Mrs. Swenson," a movie showing a housewife's solution to wiring woes. About 1,100 key businessmen are invited. Meetings will be held in central restaurants or hotels.

'Selective' Information Program

Long Island's Advertising and public information department's continuing information program will follow the "selectivity" pattern too. Besides advance and follow-up publicity about the five meetings and "Coolerama," the department will send out tailored, spot releases on how to LBE to 72 weeklies and three dailies in the company's service areas.

Emphasis will be on helpful, decommercialized publicity for the weeklies, a medium that the utility feels has a large, responsive audience.

'Miracle Cable' Boosts Wiring Sales

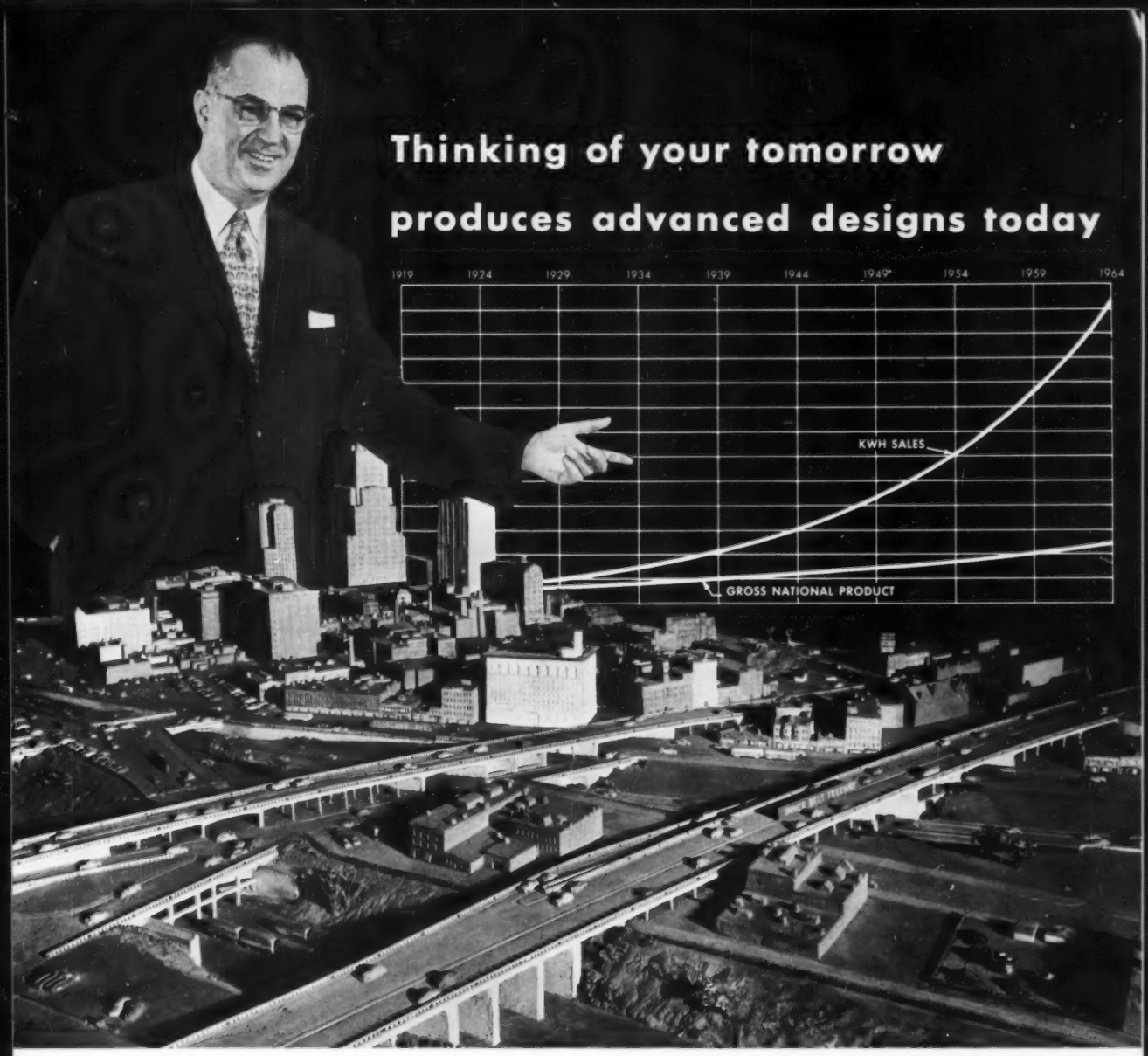
"Miracle cable," a new Washington Water Power Co promotion wrinkle, is helping whip the inadequate wiring drag in older homes that hinders dealer appliance sales.

Sponsored jointly with Inland Empire Electrical League, the campaign's "miracle cable" is a fresh label for a familiar item—115-amp No. 2 flexible cable with RH insulation. The "miracle" lies in increasing service entrance capacity from 50- and 70-amp minimums at savings of $50 or more per job. "It's like getting a 20% bonus on your electrical installation," enthusiastic dealers say.

Since "Miracle" cable was introduced last October, 95% of all service entry changes made in WWP service area home have been with the retagged cable, says William A. Lowry, residential sales supervisor. About 275 wiring jobs a month were averaged in the utility's system, despite a severe winter.

The cable boosts service entrance capacity as much as 65 amps. In-

(*Continued on page* 195)

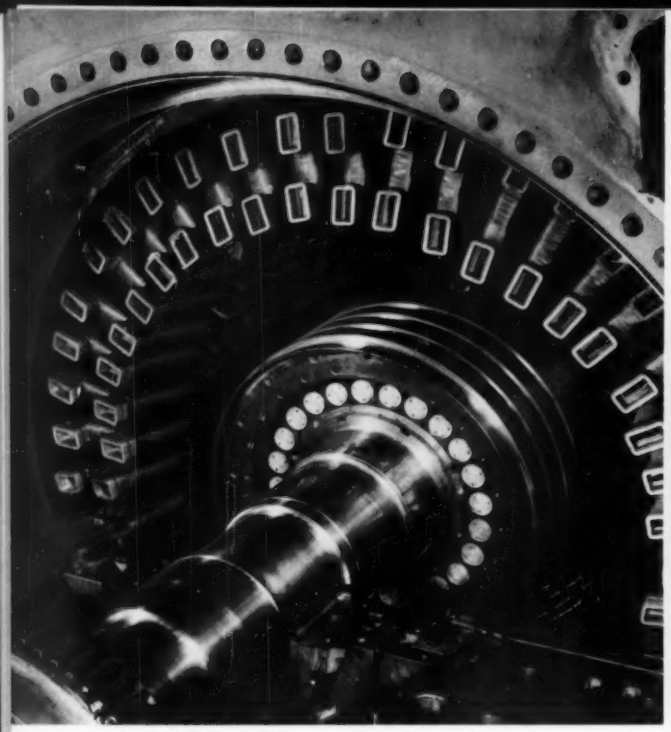


A. C. Monteith, Vice President Apparatus Products, presents some of the Westinghouse achievements in apparatus design . . . features that will help you with your load growth problems.

For a quick look at some of these Westinghouse product developments, see the next three pages.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

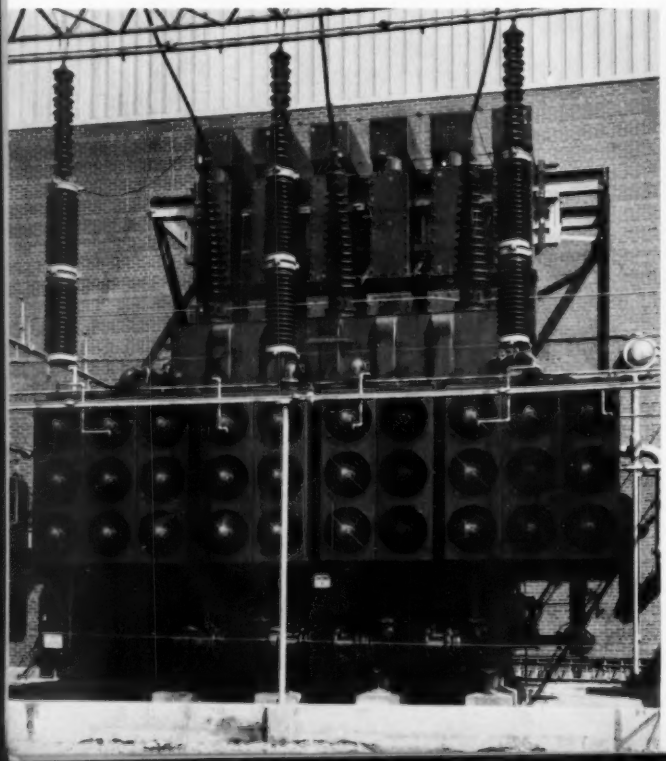


Innercooling Both Stator and Rotor, a Westinghouse first, has made it possible to double generator ratings compared with conventionally cooled units, reducing size, weight.

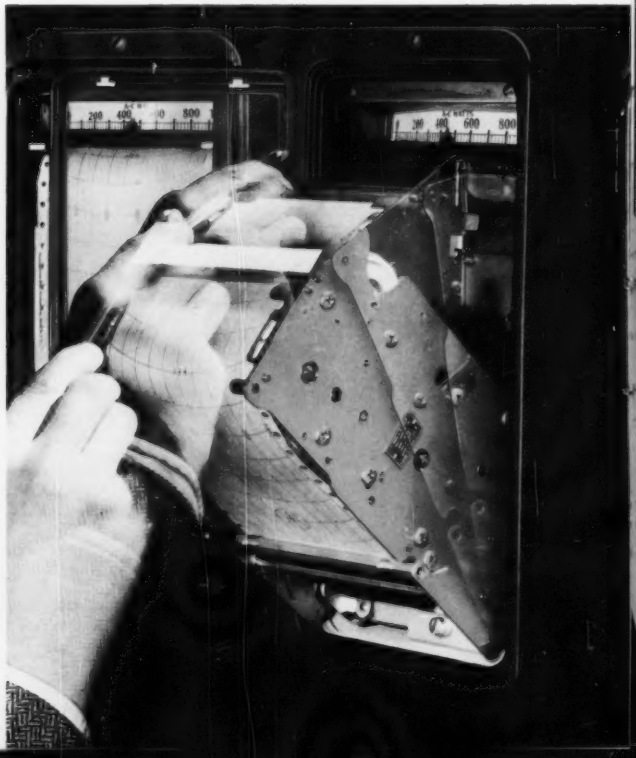
Higher Mechanical Efficiency, up to 92%, is achieved by airfoil blading . . . exclusive in Westinghouse-Sturtevant® centrifugal blowers, the most efficient fans available.

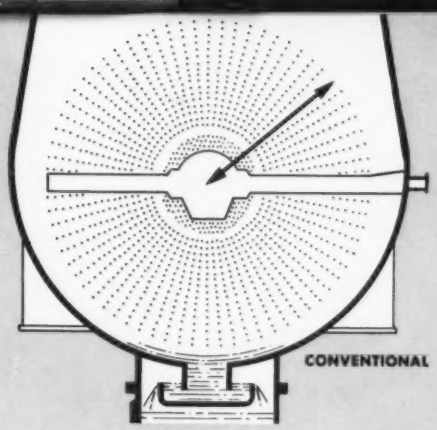
WATCH WESTINGHOUSE

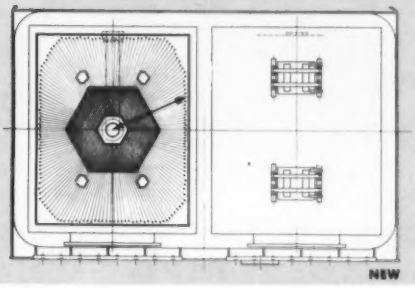
At 315,000 Kva, Largest Capacity 3-phase generator transformer ever built; smaller, lighter per kva than any other transformer. Shipped upright; on-line at Detroit Edison Co.



Twice the Torque of other designs; gives the new Westinghouse Type 44 Recorder faster response, higher fidelity. Accessibility of parts makes it the most convenient to use.







Occupies Less Space while maintaining performance; a dramatic advantage of the exclusive new Twin Bank Condenser, accomplished by dividing steam flow into two paths.

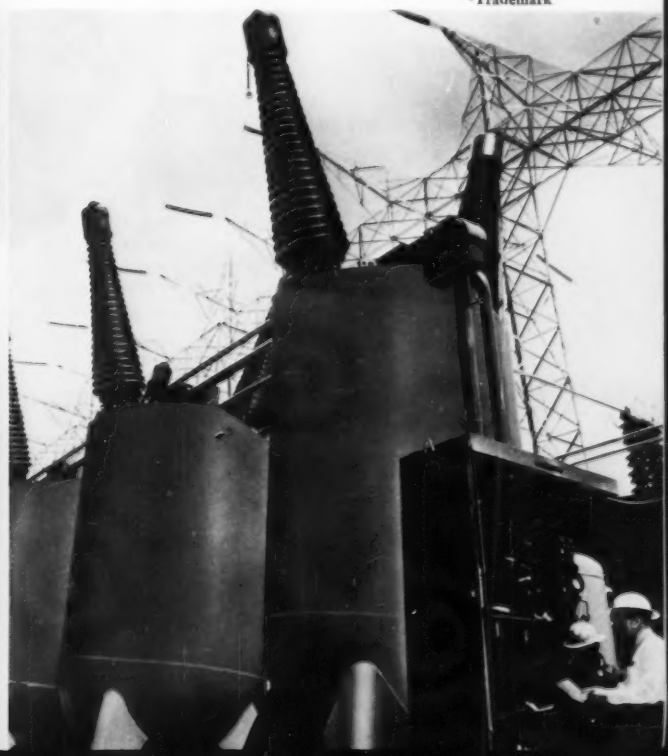
Annual Savings of $50,000 per thousand megawatts can be realized with the revolutionary new Economic Dispatch Computer, recently developed by Westinghouse.

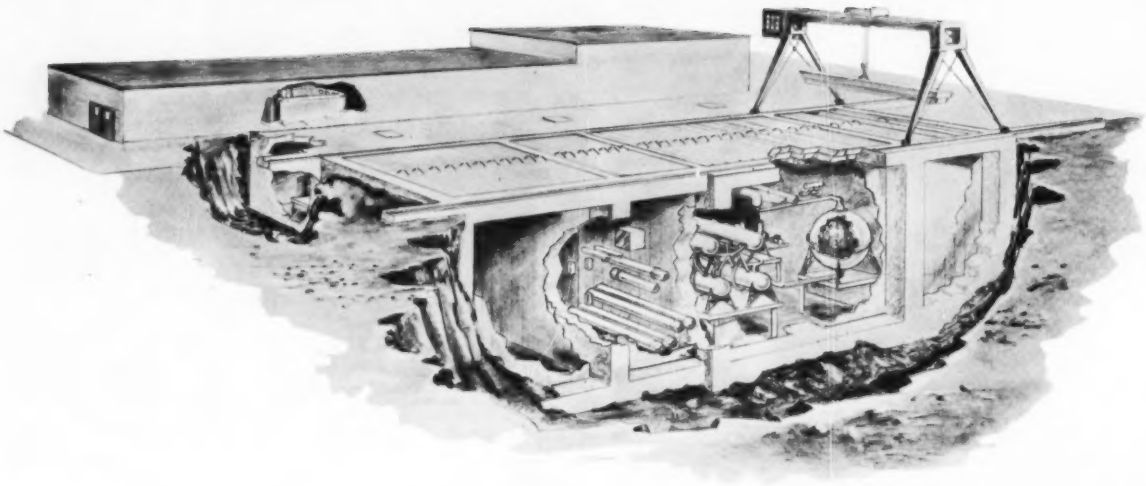
*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

Wrapped-in Dependability for powerhouse motors. That's Westinghouse Thermalastic® insulation, exclusive and still unequaled where moisture, dust and heat are problems.

World's Largest Breaker, rated 330-kv, 25,000,000-kva interrupting capacity. A Westinghouse development made possible by "Watchcase*" design, "De-ion®" grid interrupters.

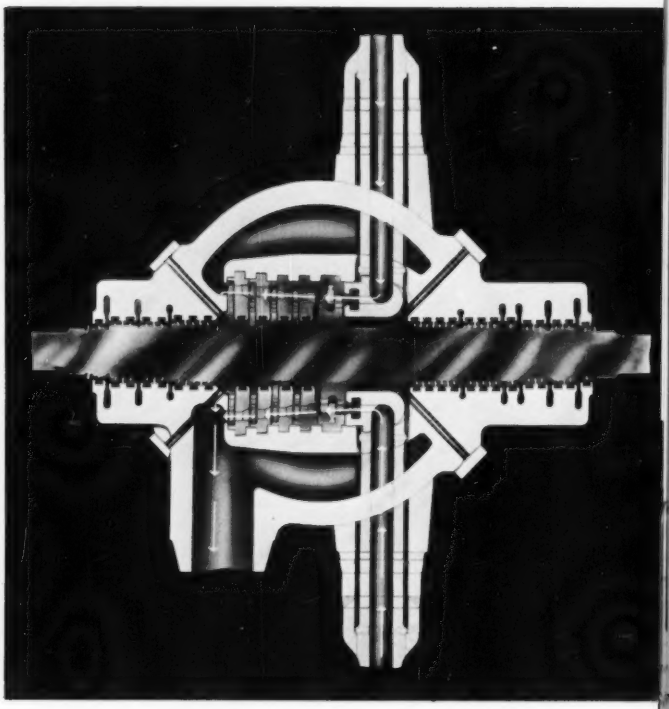
*Trademark





First in Atomic Power, Westinghouse is now pushing forward the development of a very promising aqueous homogeneous nuclear power reactor design, in partnership with the Pennsylvania Power and Light Company.

World's Most Efficient Kilowatt Producer—New supercritical pressure turbine-generator greatly reduces fuel consumption; 5000 psi, 1200°F are highest pressure and temperature ever applied commercially.



The panorama of product development shown here is just a glimpse of creative engineering at Westinghouse . . . and what it is doing for you. New concepts of power generation are inspiring new standards of apparatus capability—higher capacity, greater durability and efficiency, new sources of power. Prime objective: to help utilities meet the fantastic growth projected for the next 20 years.

For specific assistance, get in touch with your Westinghouse sales engineer, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. CP-1038

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

'Miracle Cable'

(*Continued from page* 190)

stalled in existing homes with 125-amp meter sockets, it permits use of quick recovery water heater, air conditioning, dryer, and supplementary electric heat.

Lowry reports that the rewiring has held up well—both installations and demand. He credits "excellent customer reaction" to WWP advertising (newspaper, bill board, radio and TV, demonstration and displays) with the demand for, and understanding of, "miracle cable."

To work out their campaign, WWP and IEEL won approval of code interpretations from code commissions of Washington and Idaho. The new ruling broadens the former standards of 95-amp service entrances written into most codes.

Although fourth quarter appliance sales for 1955 broke records, and first quarter sales for '56 were slightly below the new records, Lowry sees no significant disparity between these appliance sales and miracle cable. He thinks the Christmas season boosted the 1955 figure and that, with miracle cable installations becoming more general, appliance sales will tend to hold at a higher level.

S & S SHORTS

Heating Needs Sales Outlets

Is the electrical distributor to be the cause of discount houses, department and hardware stores' stocking of heating equipment? Yes, says Stanley B. Aronson, Berko Electric Manufacturing Corp, "If the manufacturer does not get cooperation from the electrical distributor, it is possible he will look for other channels of distribution." Aronson was speaking before the electric heating committee of National Association of Electric Distributors.

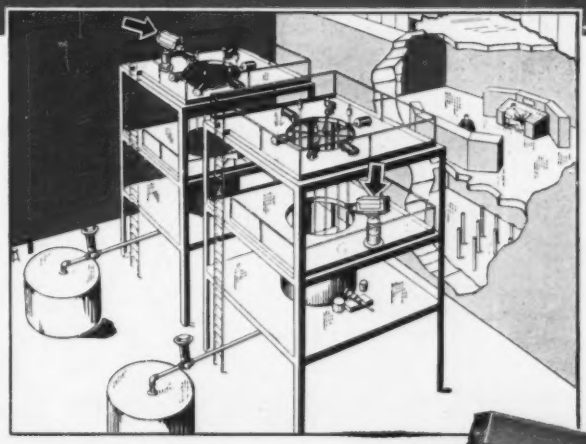
House Sales Secret

A folder, "The Secret of Selling a House," that tells builders how electric ranges can boost and/or speed sales has been printed by National Electrical Manufacturers Association for local utility distribution. They cost $10 per 100. Contact Electric Range Section, NEMA, 155 E 44th St, New York 17, N. Y.

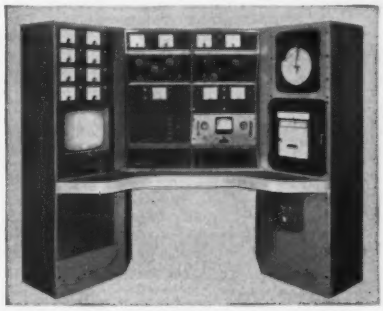
Diamond "UtiliVue" (WIRED TELEVISION)

used in NUCLEAR REACTOR STUDIES

at Battelle Memorial Institute



Arrows indicate remotely controlled "UtiliVue" Cameras that SEE experimental nuclear reactor cores.



"UtiliVue" Monitor is built into control console in separate control room where experimental nuclear reactor cores can be WATCHED in perfect safety.

"UtiliVue" pedestal enables camera to be rotated 320° and tilted 90° by remote control from console. Zoom lens (also controlled from console) brings objects into focus at widely varying distances from camera.

The "UtiliVue" is invaluable whenever there is the need for actually SEEING what is happening where it is impossible or impractical for the human eye to watch directly. There are installations of Diamond Industrial TV that have been in continuous operation since 1946. For further information, get in touch with your Graybar Distributor or use the coupon below.

7406

Distributed by Graybar

DIAMOND POWER SPECIALTY CORP.
"FIRST IN INDUSTRIAL TELEVISION"
ELECTRONICS DEPT., P.O. BOX 565
LANCASTER, OHIO

Please send me without obligation a copy of new bulletin showing how Diamond Industrial (Wired) Television will help me reduce costs, improve quality, increase sales and aid safety.

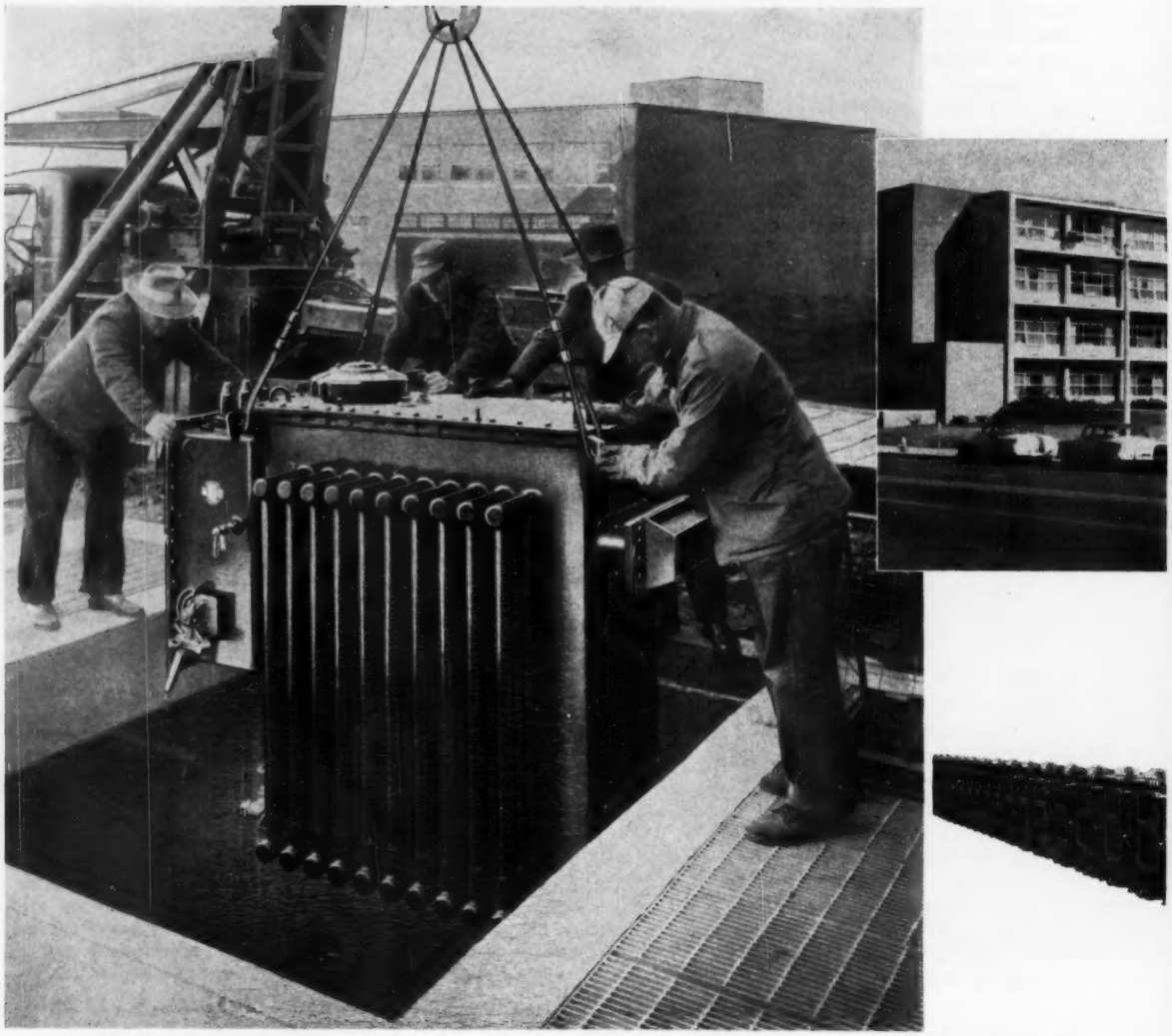
Name_____

Title_____

Company_____

Address_____

47 KUHLMAN



ONE OF THE 47 Kuhlman network transformers is shown being lowered below the street level. Each unit is a 500 KVA, 3 phase, 12480 Volt to 216Y/125 Volt submersible Saf-T-Kuhl type. A three position disconnecting and grounding switch is provided on the primary side for isolating or grounding the feeder cables during installation, testing and maintenance periods.

Specially engineered for network operation, Kuhlman's compact design saves vault space . . . reduces maintenance costs . . . withstands underground flooding and corrosive conditions.

NETWORK TRANSFORMERS

assure uninterrupted vital service for modern hospital area in Memphis

With nearly all of its hospital facilities growing and concentrated in one area, Memphis, Tennessee made careful plans for the future.

Memphis Light, Gas and Water Division engineers knew from experience that Kuhlman's dependability would meet the vital requirements of this modern hospital area. They also knew that a network system would protect service continuity under all operating conditions and offer low cost flexibility for future load increases.

As a result, 47 Kuhlman 500 KVA network transformers were installed in a project requiring an initial investment of approximately a million dollars. These units replaced the City's underground system of transformers ranging from 50 to 150 KVA. Feeder lines were increased from 4 to 12 KV.

Like Memphis and other progressive communities, it will pay you to plan the future of your growing load areas with Kuhlman network transformers. Get all the facts—write or ask for Kuhlman network bulletin CS-1200.

5610

KUHLMAN ELECTRIC COMPANY

BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA

Air Circuit Breaker

This air circuit breaker, rated 4.16 kv, 50,000 kva, is described as smaller, lighter than manufacturer's prior model and can be factory modified to fit older housings. It has main contacts of self-aligning multiple-line butt type. Separation of contacts transfers current to arcing contacts whose erosion is reportedly minimized by inlays of silver tungsten.

Hinge-type arc chute is said to improve arc interrupting ability. By removing one bolt chute can be tilted back for inspection, maintenance. Fast interruption of low magnetizing currents is claimed by a puffer that speeds movement of the arc.

Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

Network Protector

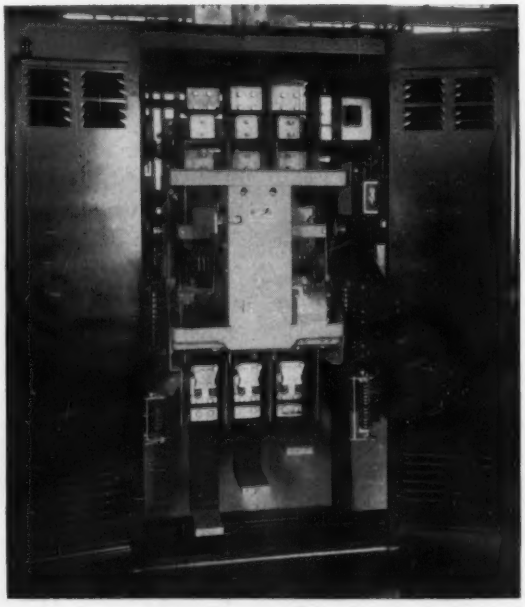
A 3,000-amp network protector has been designed for long life under extreme operating conditions and features high loading capacity built into a small unit. It operates on voltages of 120/208 and 277/480.

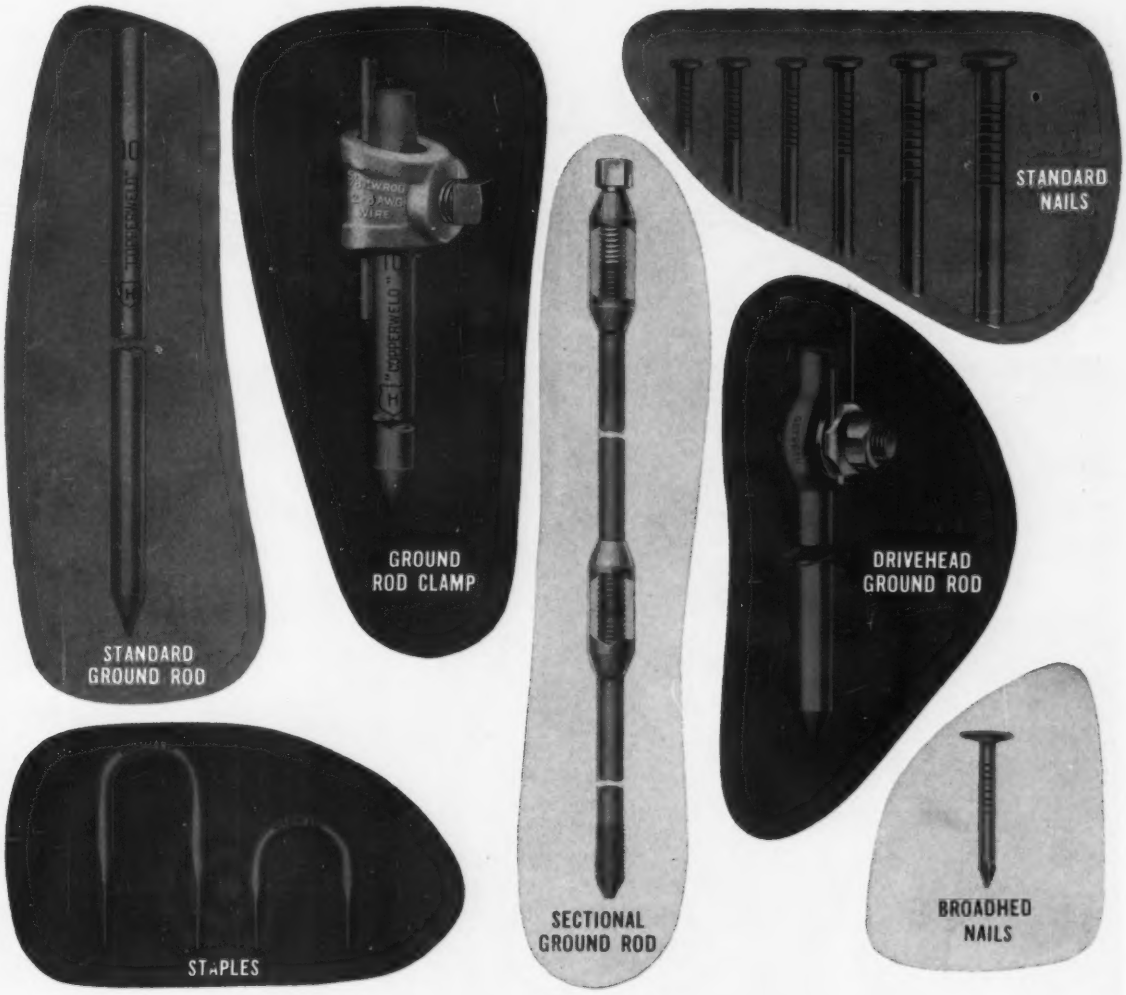
Stored energy from a motor driven mechanism provides a minimum current required to close the protector. Safety problems in 277/480-v networks are said to be cut by use of 120/208 test voltage on protector, relays, operating mechanism, and auxiliary circuits.

Testing may be performed with usual precautions for 120/208 v. Replacement parts are standardized for the protector which is designated MG-90.

General Electric Co, Low Voltage Switchgear Dept, Philadelphia, Pa.

(*More New Equipment on page* 202)





Permanently safe from corrosion
Hubbard Copperweld Hardware

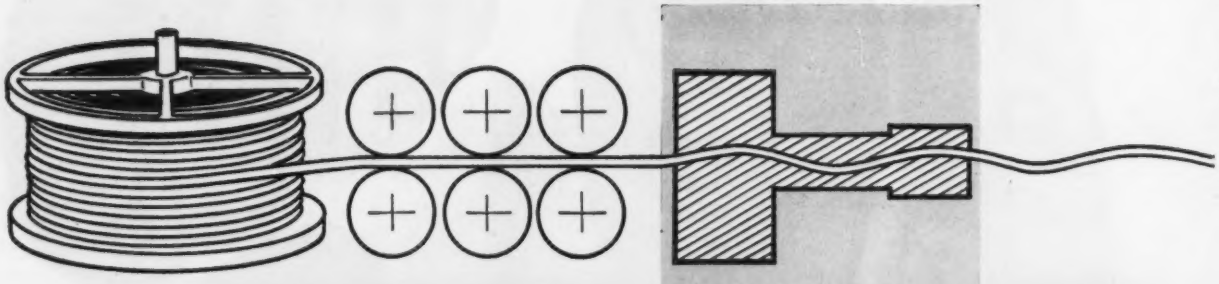
When your grounding application calls for the corrosion-proof performance of Copper combined with the strength of Steel, specify Hubbard Copperweld! Ground Rods, Sectional Ground Rods, Drive Head Ground Rods, Ground Wire Clamps, Staples and Nails are formed by the unique Copperweld molten-welding process which welds a uniform, thick sheath of Copper to an alloy Steel Core. From then on, Copperweld performs as if it were a single solid metal, installs easily, gives permanent service under the most adverse conditions of moisture and corrosion.

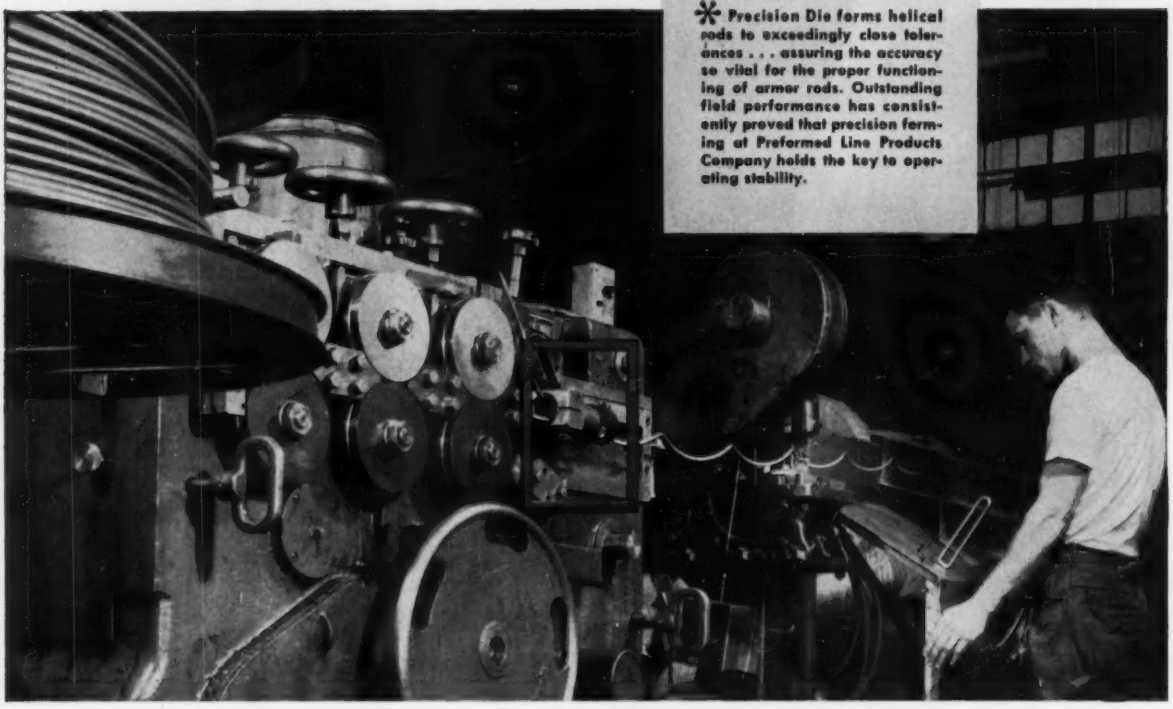
No matter what your specific hardware requirements call for, there is a Hubbard item especially designed for the job. Hubbard's four thousand items of pole line hardware are the most complete line in the industry. Several basic materials are available to allow you to match specific metal characteristics to individual conditions.

Call your Hubbard Distributor—he's an expert —for helpful answers on how to get the most out of your Pole Line Hardware dollar.

HUBBARD AND COMPANY

Pittsburgh 1, Pa.
Chicago 50, Ill.
Oakland 8, Calif.
Dallas (Plano), Texas





*Precision Die forms helical rods to exceedingly close tolerances . . . assuring the accuracy so vital for the proper functioning of armor rods. Outstanding field performance has consistently proved that precision forming at Preformed Line Products Company holds the key to operating stability.

*PRE-FORMING WITH DIES . . . *Symbol of PLP Quality*

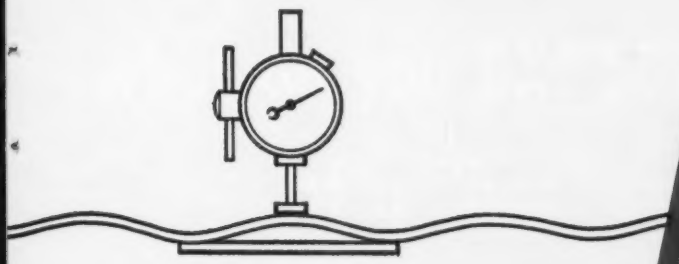
One vital element—the exclusive precision die—stands out from all others in the manufacture of Preformed Rods. Designed by Preformed Line Products Company, this special die assures absolute uniformity for all Preformed Products—converting straight rod into dimensionally exact helical rods. That's why one PLP Rod is exactly the same as another of the same size and *why all pitches within each rod are precisely the same.*

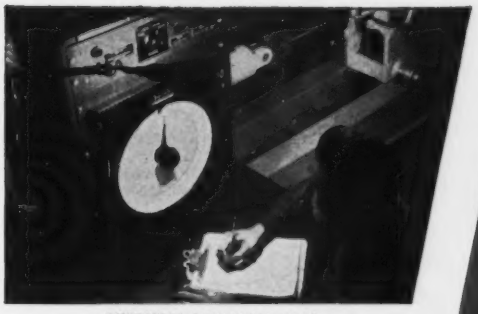
Precision-formed rods that have passed rigid quality controls mean added trouble-free performance to the user from installation to long service life. It reflects the care exercised all along the line to assure that every PLP Product meets the exacting specifications developed and constantly checked in the laboratories of Preformed Line Products Company.

Let us give you more information on their advantages; ask your local PLP Representative.

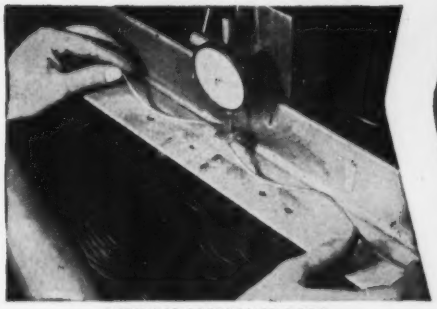
Made in accordance with or for use under one or more of the following U.S. Patents:
2,275,019; 2,587,521; 2,609,653; 2,691,865; other patents pending.

PREFORMED LINE PRODUCTS COMPANY
5349 ST. CLAIR AVENUE, CLEVELAND 3, OHIO Telephone: Cleveland EXpress 1-3571



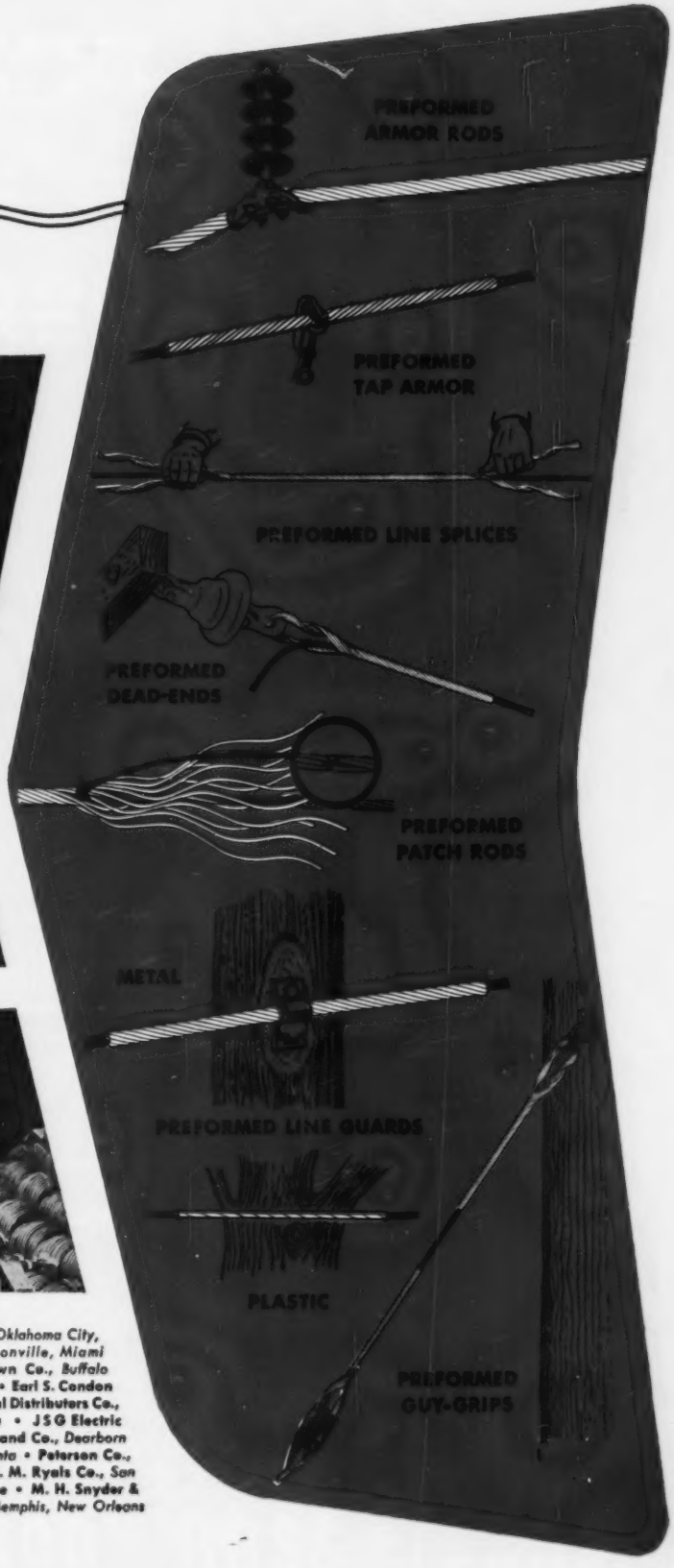


CHECKING RAW MATERIALS



CHECKING PREFORMED RODS

PACKING PREFORMED RODS



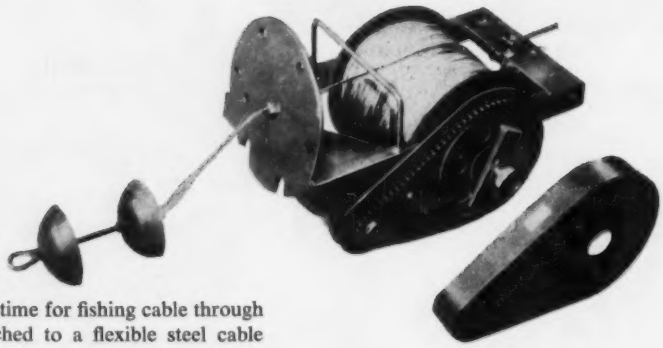
SALES REPRESENTATIVES C. B. Anderson Co., *Oklahoma City, Tulsa, Amarillo* • Belcher and Associates, Inc., *Jacksonville, Miami* Bergstrom-Verburg Co., *Minneapolis* • Vincent J. Brown Co., *Buffalo* Burns Electric Co., *Pittsburgh* • F. C. Clatterbaugh, *Omaha* • Earl S. Condon Co., *Los Angeles* • Cory and Crum, *Indianapolis* • The Electrical Distributors Co., *Philadelphia* • Engineer Sales Co. of Carolina, *Columbia* • J S G Electric Co., *Chicago* • E. L. Flowers, *Boston* • George R. Horne and Co., *Dearborn* Johnson Sales Co., *Bay City* • H. L. Macon and Co., *Atlanta* • Peterson Co., *Denver* • Elgin B. Robertson, Inc., *Dallas, Houston* • K. M. Ryals Co., *San Francisco* • Shaffer and Nelson, *Portland, Seattle, Spokane* • M. H. Snyder & Sons, *New York* • Curtis H. Stout & Co., *Little Rock, Memphis, New Orleans* L. G. Wendegatz, *Kansas City*

Overcurrent Tripper

Overcurrent tripping devices, installed since Jan. 1 on some types of air circuit breakers shipped by manufacturer, reportedly permit quick field adjustments. Adjustments can be made on time delay pickup over a range of 80 to 160% of rating and cover a range of 4 to 9 or 9 to 15 times coil rating on instantaneous pickup adjustments. The trippers are said to make it possible to adjust amount of time delay within limits of each tripping characteristic curve.

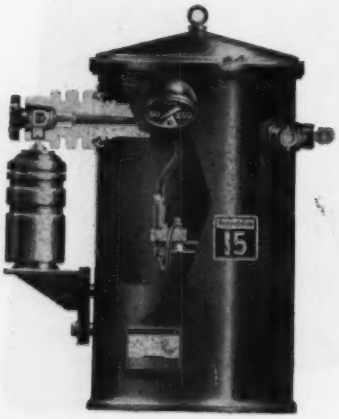
Designated EC-2, the devices are supplied for the firm's AK-1-15, AK-1-25, and AK-1-50 breakers used in cascaded and fully-rated systems. Selective system breakers will continue to use EC-1 devices. **General Electric Co, Low Voltage Switchgear Dept, Philadelphia, Pa.**

Pneumatic Fishline



A portable, pneumatic fishline, said to reduce time for fishing cable through underground conduit, shoots a projectile attached to a flexible steel cable through ". . . more than 2/3 mi of underground pipe—including 90-deg turns and bends . . ."

Bolted to pipe flange at run's beginning, fishline shoots reeled cable to target manhole where propellant air is shut off. Cleaning tools, pulling wire are then substituted for projectile. Neoprene cups fit pipes up to 10 in. **T. J. Cope, Inc, Collegeville, Pa.**



Distribution Transformers

Easy installation and maintenance, new load management tools are described as features of this distribution transformer line. They will be built in single phase ratings from 3 to 167 kva, 15 kv and below, and three phase ratings from 9 to 150 kva, 15 kv and below.

Conventional line has overload indicator that reportedly keeps permanent record of total overload hours based on copper temperatures. Main feature of CSP line is higher breaker trip settings which boost normal operating range, manufacturer says, about 20% without sacrifice in service life. **Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.**

what do you EXPECT of a "hot" line STIRRUP CLAMP?

★ ABW DESIGN MEANS QUALITY *plus* STRENGTH in the RIGHT PLACES!

- NO CONDUCTOR ARCING DAMAGE?
- QUICK, EASY INSTALLATION ON A "HOT" LINE?
- POSITIVE, EFFICIENT TIGHTENING WITH "HOT-STICK"?
- LARGE CONTACT AREAS?
- LONG, TROUBLE-FREE SERVICE?

ANDERSON answers **all** your requirements with a brand new one-piece **"Hook-over" Hotline Stirrup Clamp** . . . TYPE AHLS . . . designed for time-saving installation, longer service life and rugged, efficient dependability in service.

The heat-treated clamp body, cap and eye are high-strength cast aluminum alloy. Copper stirrup loops are serrated and compression-bonded into the clamps . . . **can't pull out!** Bolts are furnished with both flat and split washers. Hinge pins are stainless steel, and all other hardware parts are alumilite-finished high-strength aluminum alloy.

FOR MORE COMPLETE INFORMATION consult your nearest ABW representative or contact our home office.

ABW

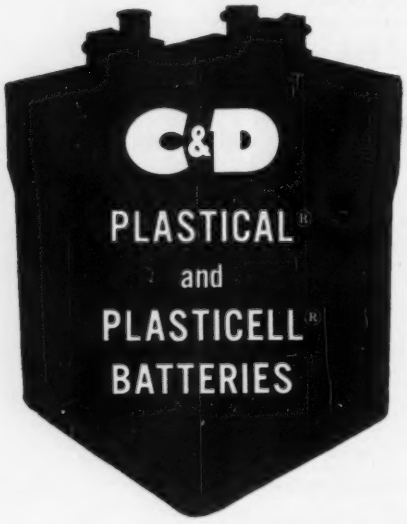
Aluminum & Bronze POWER CONNECTORS • CLAMPS • FITTINGS • ACCESSORIES
for SUBSTATION • TRANSMISSION • DISTRIBUTION SYSTEMS *for over a Quarter Century*

ANDERSON BRASS WORKS, INC.

P. O. DRAWER 2151 • BIRMINGHAM 1, ALABAMA

Now—"engineered" power

for switchgear-control —emergency lighting —auxiliary power



Compact, modern-design "power plants" engineered for specific applications! C & D PlastiCals and PlastiCells give you completely dependable power—*where power must not fail!*

PlastiCal—with lead-calcium grids for maximum life—is conservatively engineered for at least 25 years in full-float service. PlastiCell—with high-tensile alloy grids—has a projected life of 14 years in float service.

WITH BOTH PLASTICAL AND PLASTICELL YOU GET SUCH ADVANCED C & D DESIGN EXTRAS AS:

1. Extra-long life—exclusive design combines advantages of both suspended and supported plate construction.
2. Triple insulation—thick Fiberglas mat, microporous separators, and perforated Koroseal retainer.
3. Saftee-Vent—outstanding C & D development that prevents accidental battery explosions.
4. Crystal-clear plastic jars—heat-resistant and hermetically sealed.
5. Plastite Post Seals—for easier maintenance, and at the lowest lifetime cost.

Write for C & D Specification Bulletins:
CP-536 Rev. 1 on PlastiCal Batteries
CP-537 Rev. 1 on PlastiCell Batteries

C&D BATTERIES, INC.
of Conshohocken, Pa.
Industrial Batteries since 1906

SALES AND SERVICE OFFICES IN PRINCIPAL CITIES FROM COAST TO COAST

Conduit Bushing Drop Out

An addition to a prefabricated metal trough system for cable support is a conduit bushing drop out which allows cable to pass from the trough into a conduit. The aluminum drop out provides a smooth surface that protects the cable insulation.

The drop out can be placed anywhere in the trough system by cutting a hole in the trough and attaching the drop out to the trough by bolts. Manufacturer reports that a clamp operated by a hollow head bolt assures that the slotted collar will grip the threaded conduit securely and provide a continuous metallic connection. Necessary bolts are furnished with the fittings.
T. J. Cope, Inc, Collegeville, Pa.

Non-Returnable Reel

Non-returnable, quality-controlled wire spools and reels are designed to accommodate all types of fine wires in most tempers. The moisture-resistant, chemically inert spool, fabricated from a plasticized wood by-product, consists of molded flanges, heavy walled craft barrel, and light weight steel reinforcements.

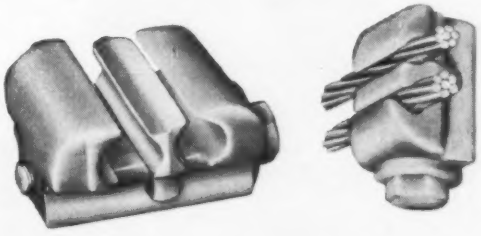
The units are now available in 90 to 100-lb capacities, but other sizes are planned.
Hubbard Spool Co, Garrett, Ind.

(*More New Equipment on page* 206)

MEET EVERY ALUMINUM NEED QUICKER, BETTER WITH

FARGO "9000" SERIES

ONE-PIECE ALUMINUM CONNECTORS

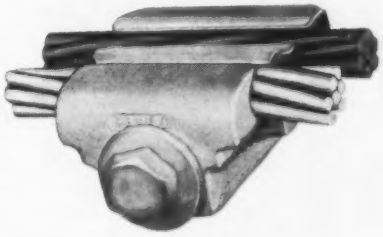


FARGO ALUMINUM CONNECTORS
for aluminum to aluminum

Featuring the unique vise type, one piece construction of all Fargo connectors, the aluminum "9000 Series" have extra width and mass. Large contact areas overcome high contact resistance inherent in aluminum . . . provide ample radiating surfaces and lower temperature rise at points of contact.

FARGO PLATED ALUMINUM CONNECTORS
for bimetal or aluminum to aluminum

These plated "9000 Series" connectors permit a substantial reduction in the number of clamps stocked . . . one clamp for aluminum to aluminum or aluminum to copper connections. Pure aluminum spacer bar insures a short high conductivity path between conductors with adequate separation. Wide parabolic jaws minimize conductor cold flow and distortion.



FARGO ALUMINUM CONNECTORS
for aluminum to copper

Transition between copper conductor and aluminum casting is provided by a bimetal insert of pressure welded aluminum and copper sheet. Wide jaws and efficient conductor encirclement bring each strand under a "pressure zone" to reduce interstrand resistance. Extra mass assures lower joint temperatures under normal or fault currents.

The aluminum body of all Fargo "9000 Series" Connectors is made of high strength, age-hardening alloy. Spacer bars are cast from soft, pure aluminum that forms snugly around conductor strands and preserves clean contact surfaces. There's a full range of standard sizes covering all sizes and combinations from #8 Solid through 500 MCM.

Ask your Line Material Field Engineer for complete details.

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, New York

FARGO

Distributed by
LINE MATERIAL COMPANY
(A McGraw Electric Company Division)
Milwaukee, Wisconsin
In Canada, CANADIAN LINE MATERIALS, LTD., Toronto, Canada

for insulated wire, one source Continental

For the run-of-the-mill wiring problems—or the hundreds of specials—the one source for practically all types of permanently insulated wire—is Continental. Whether it's electronic hook-up wire, military hook-up wire or cable, switchboard AVB—TA—SHFS Cable or Wire . . . Asbestos, Glass, Nylon, Varnished Cambric, Polyethylene, etc. . . . the **Always Correct Source** is Continental Wire Corporation. Refer your special wiring problems today to Continental's Wire and Cable specialists.

*A.C. Source

ADDRESS: Continental Sales, Box 363, Dept. CWS-2
Wallingford, Conn. Phone COlony 9-7718.

SWITCHBOARD and RHEOSTAT WIRE—TYPE AIA
600 VOLT SERVICE
Available Sizes: 18 to 4/0 AWG inclusive

Solid copper conductor, asbestos insulation, asbestos braid . . . heat, flame and moisture resistant. U.L. Approved. Ideal for wiring rheostats, switchboards, control panels, and ovens where oil, grease, corrosive vapors, moisture **and high temperatures** are present. Maximum operating temperature 257°F.

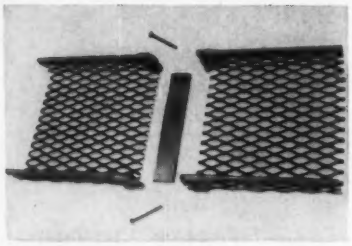
Continental
WIRE CORPORATION
WALLINGFORD, CONNECTICUT • YORK, PENNSYLVANIA

Heavy-Duty Trucks

A line of heavy-duty trucks featuring three V-8 engines is designated the "V-Line." It comprises nine series of trucks in conventional and cab-over-engine, four and six-wheel design. Models are available with gross vehicle weight ratings of 12 tons and up and gross combination weights of 25 tons and up.

Power is supplied by International V-8 engines of 401, 461 and 549-cu in. displacement with ratings of 206, 226 and 257 hp respectively.

International Harvester Co, 180 N. Michigan Ave, Chicago 1, Ill.



Pin-Type Coupler

Sections of a support system for instrument tubing can be connected by a pin-type coupler which requires only two pins and a slotted aluminum plate. The plate overlaps the bottom of two connecting supports, and the pins are driven into place through interlocking barrels on the sides.

Instrof Corp, Division of T. J. Cope, Inc, Collegeville, Pa.

MORE NEW PRODUCTS

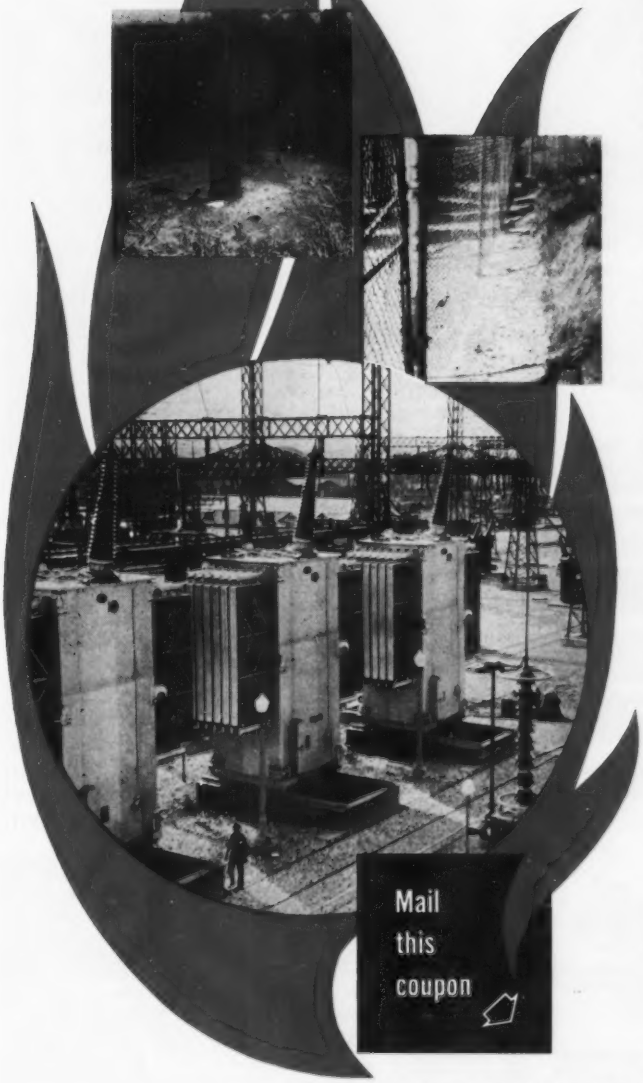
Pass & Seymour, Inc, Syracuse, N. Y., has a **weatherproof duplex outlet** that can be installed by drilling only one hole. The unit is available complete with mounting box and is rated 15 amp, 125 v.

Metropolitan Wire Goods Corp, 70 Washington St, Brooklyn 1, N. Y., has **steel rod shelving** that is assembled without nuts, bolts or screws. The material used is heavy weight steel rod, notched to close tolerance so that shelves and uprights are quickly locked into place.

(*More New Products on page* 208)

PROTECT YOUR PROPERTY AGAINST GRASS FIRES!

here are two good ways to destroy fire-hazardous weeds and grasses...



You have a choice of either spraying, or applying a granular weed killer which goes on dry. By either method you can destroy most weeds and grasses *and prevent regrowth* for a full season or longer! Choose one of these two popular weed killers for keeping *your* grounds free of unsightly, hazardous weeds.

UREABOR* WEED KILLER

For DRY application; there is nothing to mix... no water to haul. UREABOR is always ready for use in its delivered form; gives full season control of most weeds and grasses. It is so powerful that only 1 to 2 lbs. per 100 sq. ft. is effective, yet safe. For most efficient distribution of UREABOR at low rates, we recommend the PCB Spreader. Available for just $10.75 delivered—anywhere in the U.S.A.

**Trade-mark of B.C.L.*

POLYBOR-CHLORATE®

Apply this weed killer as a spray, or dry. Spraying gives quick knockdown to tall standing vegetation... kills topgrowth... attacks roots. Remains in soil to prevent regrowth for as long as two years. Although this herbicide is a combination of sodium borates and sodium chlorate, it is nonflammable and nonpoisonous when used as directed.

√ Check these features:

- **EASY TO APPLY... AND SAFE**
- **RESULTS ARE LONG-LASTING**
- **NONSELECTIVE • NONPOISONOUS**
- **NON FIRE-HAZARDOUS**
- **NONCORROSIVE to ferrous metals**

Mail this coupon

AGRICULTURAL SALES DIVISION

PACIFIC COAST BORAX CO.

DIVISION OF BORAX CONSOLIDATED, LIMITED

630 SHATTO PLACE, LOS ANGELES 5, CALIFORNIA

Please send literature to:

NAME_____

COMPANY_____

ADDRESS_____

CITY & STATE_____

FLINT
STEEL CORPORATION
TULSA - - - - - - - - MEMPHIS

This emblem on fabricated steel is assurance that it has been fabricated in compliance with industry codes. The facilities and personnel to fabricate products in strict accordance to customer's specifications.

FABRICATED REINFORCING STEEL
STEEL WAREHOUSE DISTRIBUTORS
FABRICATED STEEL PLATE
FABRICATED GALVANIZED STEEL
FABRICATED STRUCTURAL STEEL

CONCRETE REINFORCING STEEL INSTITUTE C.R.S.I.
AISC

for over 40 years
FLINT STEEL CORPORATION
TULSA . . . MEMPHIS

More New Products

(*Continued from page* 206)

Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa., has packaged an **electrical joint compound** (No. 2) in a plastic squeeze bottle. The compound removes oxide film from aluminum or copper fittings and conductors.

Thomas & Betts Co, Elizabeth, N. J., has a **plastic bushing cap** that snaps into conduit bushings, insulated bushings, connector hubs, and conduit ends.

Sylvania Electric Products, Inc, 1740 Broadway, New York 19, N. Y., has a group of **lighting fixtures** available in four different styles of shielding for modern low ceilings.

Minneapolis-Honeywell Regulator Co, Minneapolis 8, Minn., has an electronic **air-conditioning selector panel** for remote adjustment of temperature in commercial applications.

Enflo Corp, Route 38, Pennsauken, N. J., has **Teflon tape** that is 0.0005 in. thick. It finds use in capacitors, transformers, and for both wrapped and sintered wires and cables.

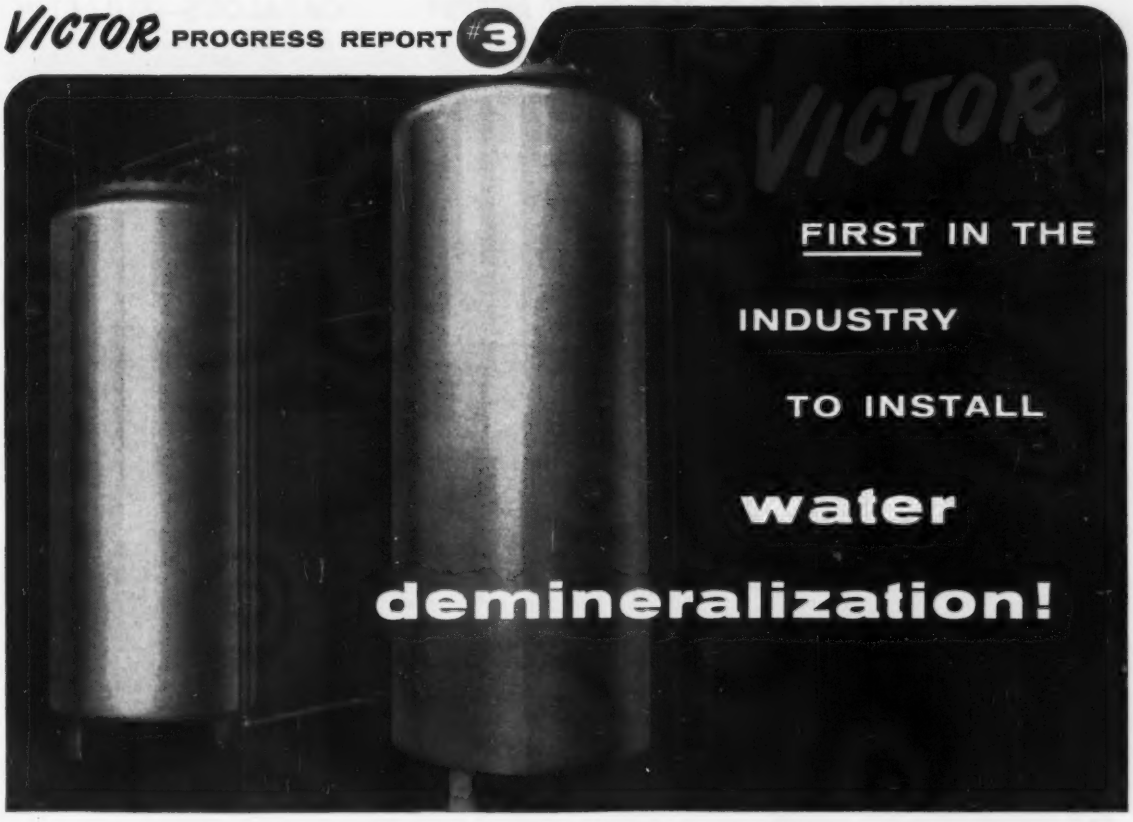
Airmatic Valve, Inc, 7317 Associate Ave, Cleveland 9, Ohio, has a 2-way direct **solenoid-controlled valve** designed for easy inspection and service. All control parts can be removed in one small assembly.

Edwards Co, Inc, Norwalk, Conn., has a **manual fire alarm system** that indicates location of the fire. Warning devices and alarm stations are wired through a closed-circuit to a supervisory control panel.

Robbins & Myers, Inc, Springfield, Ohio, has added three motors to its line of all-weather, **capacitor single-phase motors.** The high-torque capacitor-start capacitor-run motors—two rated 10 hp and one at 15 hp—are available in 1,725 and 1,140-rpm speeds.

General Electric Co, Schenectady 5, N. Y., has an ac **crane control panel** for NEMA Class II service applications. It features easy-access wiring, all front-connected devices, and removable doors.

VICTOR PROGRESS REPORT #3



Victor's extensive ceramic research first brought to light the fact that minerals in processing water cause microscopic agglomerates of glass-like impurities which result in fluctuations in insulator characteristics. As a result, Victor was the *first* porcelain insulator manufacturer to install water demineralization equipment, part of which is shown above. For several years, *all* processing water used in Victor's plant has been demineralized.

Exhaustive tests have proved that Victor *Purified* Porcelain Insulators, made with demineralized water, have: (1) improved thermal resistance; (2) unmatched porcelain hardness and density; (3) higher average puncture values, and (4) better tension, torsion, cantilever and impact values.

Another example of Victor's ability to give you better insulators through research and modern manufacturing facilities.

SPECIFY VICTOR
Purified Porcelain
Insulators!

I-T-E
VICTOR INSULATORS DIVISION
I-T-E CIRCUIT BREAKER CO.
VICTOR, N. Y.

Low and High Voltage Pintypes • Suspensions • Guy Strains
Spools • Switch and Bus Insulators • Custom Designed Porcelain
Insulator Hardware

"BETTER INSULATORS THROUGH RESEARCH"

Wherever you need a 3½ or 5KW power package

New ONAN CCK Electric Plants

give you more of what you want most!

★ MORE OUTPUT PER POUND OF WEIGHT
★ MORE OUTPUT PER GALLON OF FUEL
★ MORE OUTPUT PER DOLLAR COST!

MODEL 305CCK
3,500 watts A.C.
MODEL 5CCK
5,000 watts A.C.

Powered by longer-life, short-stroke engines

Onan has wrapped up all the time-tested Onan quality features with outstanding new design advances in these versatile power packages. Measure them by any standard . . . put them to work on any job . . . and you'll rate these new Onan units as leaders in value, way-ahead in performance.

More powerful, two-cylinder, air-cooled Onan engines of 4-cycle, horizontally-opposed, alternate-firing design, give smooth, quiet, effortless performance. Short stroke and moderate speed cut engine wear, give longer life. Quality features include rotating Stellite-faced exhaust valves, solid Stellite valve seat inserts and full pressure lubrication.

For difficult installations . . . in a closed compartment or "buried" within a vehicle, Onan's exclusive Vacu-Flo cooling system is available as an optional feature.

Like all Onan Portable Electric Plants, CCK units are completely Onan-built, with Onan engines direct-connected to Onan all-climate generators in compact, rugged units. Available in stationary, portable and standby models with a wide range of accessories giving them all-around versatility.

PORTABLE MODELS Equipped with carrying frame as shown or mounted on 2-wheel, rubber-tired dolly, the CCK makes a high-capacity, easily portable, package of electric power. Other Onan models: 500 to 50,000 watts.

Special folder describes 12 new CCK models. Write today.

Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

2944 University Avenue Southeast, Minneapolis 14, Minnesota

CATALOGS—BULLETINS

• **VINYL JACKETING:** Problems involved in development of weather-resistant vinyl compounds and the progress which has been made toward their resolution are discussed in Kabelitems No. 89. Bakelite Co, 30 E. 42 St, New York 17, N. Y.

• **INDUSTRIAL SOLENOIDS:** Bulletin No. GEA-6215A, 16 pages, gives application and accessory data on a line of industrial strongbox solenoids. Descriptions of terminal covers and linkage pins and detailed outline dimensions on ac strongbox solenoids are included. General Electric Co, Schenectady 5, N. Y.

• **ELECTRICAL RESINS:** Scotchcast brand synthetic resin products for electrical use are described in a 4-page booklet. A chart lists all Scotchcast resins illustrating pot life, cure times, filler content, recommended applications, and temperature classifications. Minnesota Mining & Mfg Co, Dept D6-81, 900 Fauquier St, St. Paul 6, Minn.

• **FLUORESCENT FIXTURE:** Bulletin No. GEA-6436A describes a fluorescent lighting fixture known as fluorofiood and its applications. General Electric Co, Schenectady 5, N. Y.

• **STEEL TUBING:** Line of steel pipe and tubing for high-temperature service is described in 6-page Bulletin No. TDC-163A. It gives mechanical and physical properties, creep, rupture and short time tensile strength, and other data on the tubing line. Babcock & Wilcox Co, Beaver Falls, Pa.

• **HEAT EXCHANGER:** An extended surface design of heat exchanger with longitudinally finned tubes is described in Bulletin No. 1401, 20 pages. It gives data on design, applications, specifications, and dimensions. Griscom-Russell Co, Massillon, Ohio.

• **WIRE ROPE:** Wire rope recommendations for industrial services are given in 24-page Bulletin No. DH-128D. Rope diameters, construction, preforming, lay, grade, core and other recommendations are given for more than 120 different types of wire ropes. American Chain & Cable Co, Inc., Wilkes-Barre, Pa.

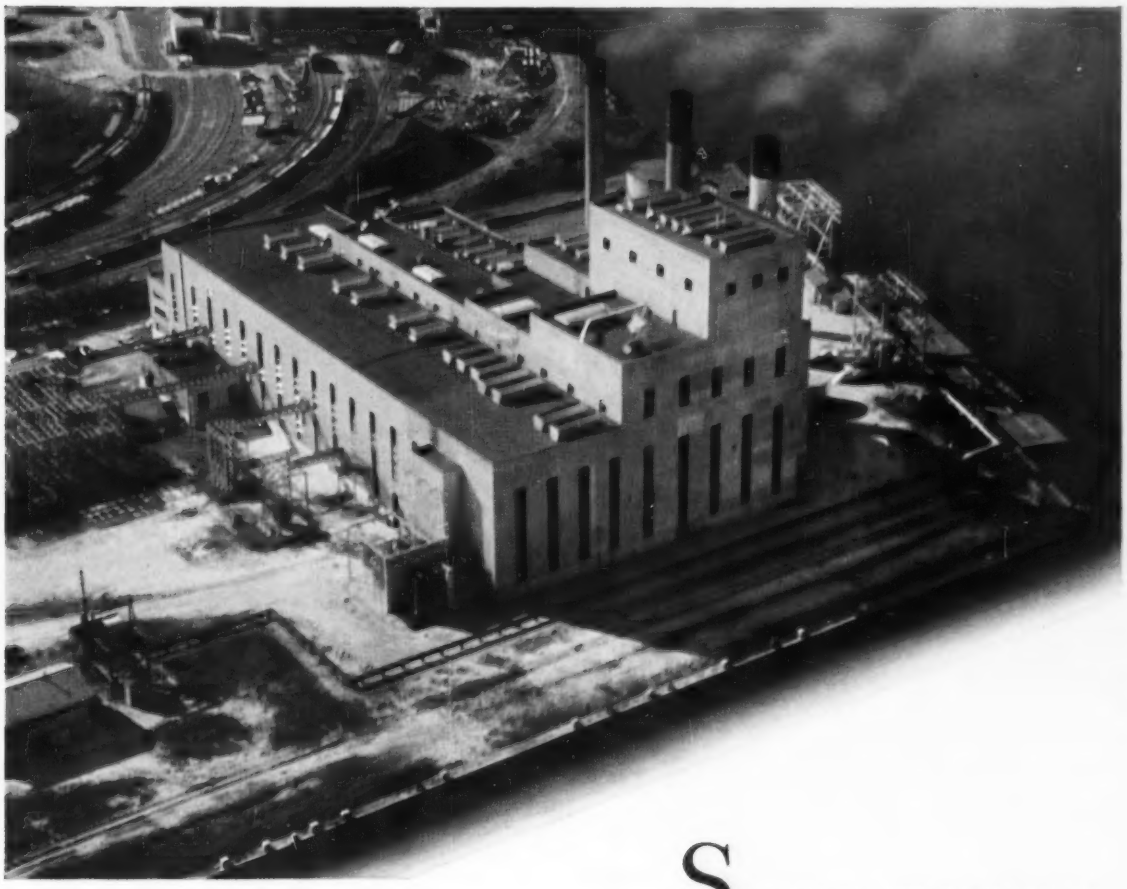
• **PUMPS:** Redesigned line of Class DMV-DHV single-stage centrifugal pumps is subect of Bulletin No. 7248-A, 8-pages. Construction features and selection tables are given for the horizontally split, single-stage pumps in sizes from 3 to 6 in. and capacities to 2,400 gpm. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

• **TURBINE GEARS:** High-speed reduction gears for mechanical-drive steam turbines are described in Bulletin No. DB 1165. It gives dimensions, weight specifications, and description of the various parts of the gear assembly. Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

• **DEHUMIDIFICATION:** Principles of dehumidification are explained and a line of dehumidifiers are described in Bulletin No. 496, 6 pages. Abbeon Supply Co, 179-15 Jamaica Ave, Jamaica, N. Y.

(*More Catalogs on page* 213)

MEETING TAMPA'S DEMAND FOR POWER



The new 66,000 kilowatt unit at Hookers Point includes the first large pressurized furnace boiler installation in this country. Steam is delivered at 1250 psi and 950° F.

Since the end of World War II, the demand for electric power in Tampa, Florida, has increased nearly 500 per cent. To keep pace with this phenomenal load growth, Tampa Electric Company recently completed a 66,000 kilowatt addition to its Hookers Point Power Station.

The initial installation at Hookers Point in 1948 consisted of a single unit of 30,000 kilowatts. In 1950 two additional units of similar capacity were installed, and in 1952 a fourth unit of 44,000 kilowatts was added.

With the completion of the new unit in 1955, the total capability of Hookers Point is now approximately 240,000 kilowatts.

Design and construction of the entire station was by Stone & Webster Engineering Corporation.

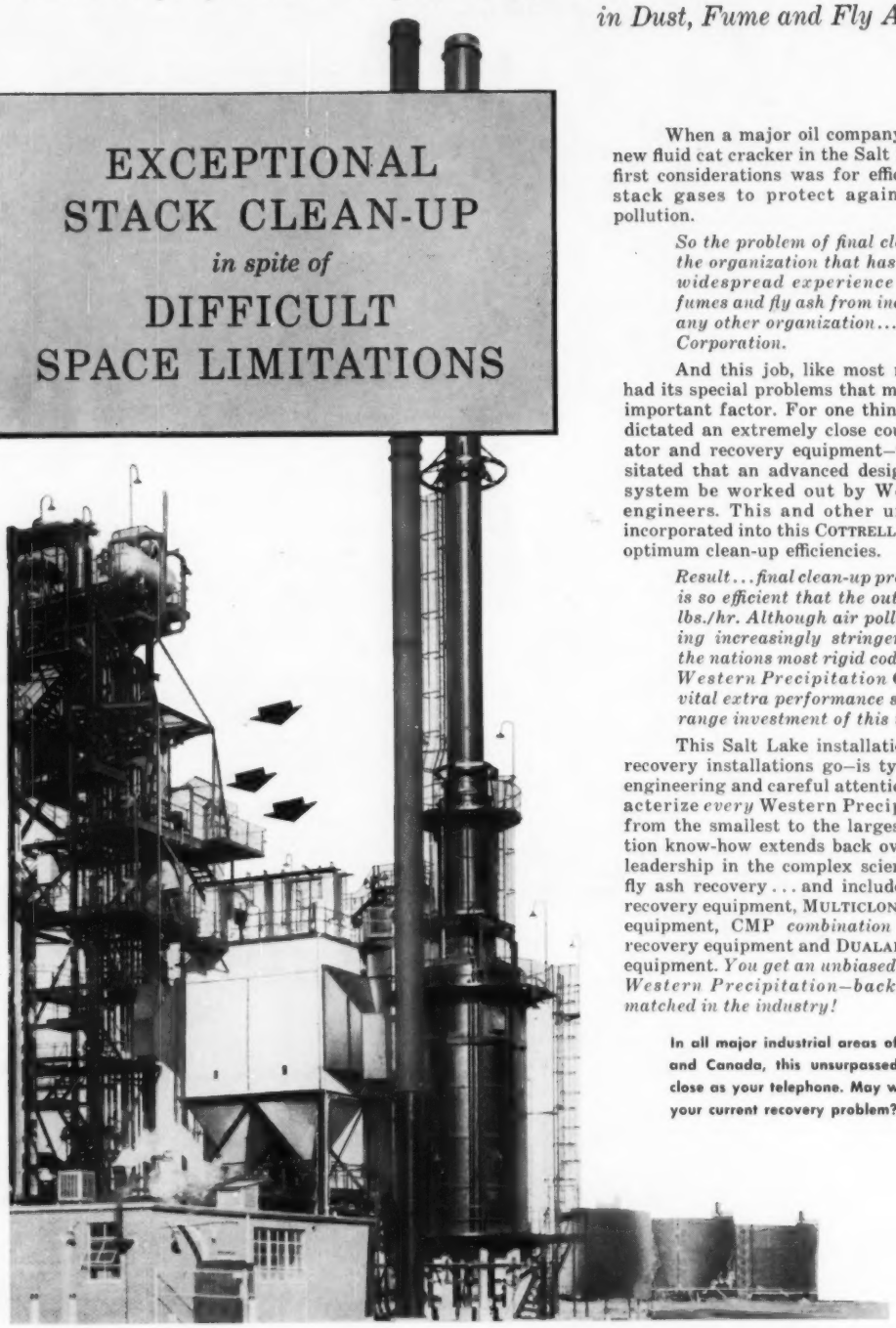
STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

Another example of Western Precipitation Know-How
in Dust, Fume and Fly Ash Recovery . . .

EXCEPTIONAL STACK CLEAN-UP *in spite of* DIFFICULT SPACE LIMITATIONS



When a major oil company recently installed a new fluid cat cracker in the Salt Lake area, one of the first considerations was for efficient clean-up of the stack gases to protect against detrimental air pollution.

So the problem of final clean-up was brought to the organization that has more know-how, more widespread experience in recovering dusts, fumes and fly ash from industrial gases than has any other organization...Western Precipitation Corporation.

And this job, like most recovery installations, had its special problems that made *experience* an all-important factor. For one thing, space requirements dictated an extremely close coupling of the recuperator and recovery equipment–which, in turn, necessitated that an advanced design of gas distribution system be worked out by Western Precipitation engineers. This and other unique features were incorporated into this COTTRELL Precipitator to insure optimum clean-up efficiencies.

Result...final clean-up provided by the COTTRELL *is so efficient that the outlet loading is only 9½ lbs./hr. Although air pollution codes are becoming increasingly stringent, this far surpasses the nations most rigid codes–further proof that Western Precipitation* COTTRELLS *deliver that vital extra performance so important on a long-range investment of this type.*

This Salt Lake installation–not a large job as recovery installations go–is typical of the advanced engineering and careful attention to details that characterize *every* Western Precipitation installation, from the smallest to the largest. Western Precipitation know-how extends back over almost 50 years of leadership in the complex science of dust, fume and fly ash recovery . . . and includes COTTRELL *electrical* recovery equipment, MULTICLONE *mechanical* recovery equipment, CMP *combination* electrical-mechanical recovery equipment and DUALAIRE *filter* type recovery equipment. *You get an unbiased recommendation from Western Precipitation–backed by know-how unmatched in the industry!*

In all major industrial areas of the United States and Canada, this unsurpassed experience is as close as your telephone. May we be of service on your current recovery problem?

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

Main Offices: **1004 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA**

Chrysler Building, New York 17 • 1 North La Salle Street Building, Chicago 2 • Oliver Building, Pittsburgh 22 • 3252 Peachtree Road N. E., Atlanta 5 • Hobart Building, San Francisco 4

Precipitation Company of Canada Ltd., Dominion Square Building, Montreal

Representatives in all principal cities

Catalogs—Bulletins

(*Continued from page* 210)

● **FIBRE CONDUIT:** Catalog No. 52, 12 pages, outlines uses of Orangeburg fibre conduit, an underground protective raceway for electric cables. Orangeburg Mfg Co, Inc, Orangeburg, N. Y.

● **DC MOTORS:** Bulletin No. GEA-6355, 12 pages, describes the Kinamatic line of dc motors rated 1 to 150 hp. Dimensions, ratings, electrical and mechanical features are covered. General Electric Co, Schenectady 5, N. Y.

● **CABLE TROUGH:** Installations, load charts, and accessory items for a line of safety grating and cable trough are described in 12-page catalog. Globe Co, 4000 S. Princeton Ave, Chicago 9, Ill.

● **MEASURING EQUIPMENT:** Bulletin No. GEC-1016 is a 40-page testing-instruments reference book. It contains product and application data on color, leak detection, insulation, and radiation monitoring instruments. General Electric Co, Schenectady 5, N. Y.

● **PANEL INSTRUMENTS:** Features, application, construction, dimensions and other data on 2½, 3½ and 4½-in. panel instruments are given in Bulletin No. GEC-368H, 12 pages. General Electric Co, Schenectady 5, N. Y.

● **FITTINGS:** Copper-to-copper, copper-to-aluminum, and aluminum-to-aluminum fittings are described in a 44-page catalog. Ground rods and accessories, terminal lugs, compression fittings, and hoists are also covered. Illustrations, dimensional drawings, and descriptive data are given for each product. Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

● **TEFLON:** Applications and descriptions of Teflon rods, tubing, tape and other products are given in Catalog No. T-55, 14-pages. Continental-Diamond Fibre Division of Budd Co, Inc, Newark, Del.

● **SIDE-BREAK SWITCHES:** Bulletin No. 5604 covers the PMB-40 line of horizontal single side-break, braidless, group-operated switches. Weights, dimensions, and tabular data are given for the line rated from 7.2 to 161 kv, 400 to 1,200 amp. H. K. Porter Co, Inc, Delta-Star Electric Division, 300 Park Ave, New York 22, N. Y.

● **TEMPERATURE CONTROL:** Line of temperature controls and allied equipment for industrial heating and refrigeration from —30 to 1,200F is described in 8-page Catalog No. CC. Partlow Corp, 2 Campion Rd, New Hartford, N. Y.

● **TURBINES:** Mechanical-drive turbines, operating at speeds up to 10,000 rpm, are described in Bulletin No. GEA-6232. Construction and design features of the turbine drives for centrifugal compressors and blowers are covered in the 28-page brochure. General Electric Co, Schenectady 5, N. Y.

● **VARIABLE SPEED DRIVES:** Bulletin No. 20P50 describes variable speed Texrope drives. The 40-page booklet gives selection tables, design features, drive principles, and ratings. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

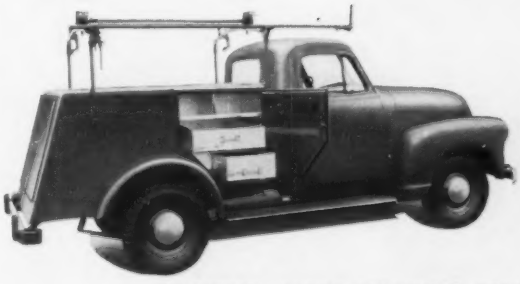
thousands of

YORK-HOOVER

MODEL 20IU76'S

earn extra dollars every day!

Illustrating latest type ladder bracket and adjustable partitioned drawers. Large interior provides a compact and orderly storeroom for materials and tools.



Right side view showing extra large material and tool drawers. Convenient location facilitates quick inventory for everyday service work.

QUICKER, MORE EFFICIENT SERVICE

This Model 20IU76 Service Body will provide many years of dollar-saving service for you. First, because compact design and lightweight, yet rugged, construction, combine to facilitate quicker, more efficient, service work. Second, because the Model 20IU76 Service Body is built by York-Hoover . . . a famous name in the transportation industry since 1892. Write for complete information today!

YORK-HOOVER MODEL 20IU76 SERVICE BODIES ARE EASY TO OBTAIN REGARDLESS OF YOUR LOCATION

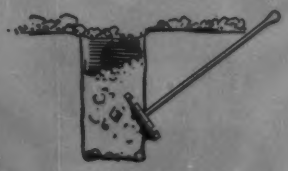
GET THE FACTS! Write for Bulletin 937 today.

YORK-HOOVER
PUBLIC UTILITY BODIES

YORK-HOOVER CORPORATION
BODY DIVISION
YORK, PENNSYLVANIA

CHANCE PLATE ANCHORS

We won't ask you to take a Mole's word for it, but you need to be a Mole to know what goes on below "see" level in an anchor installation unless the anchor fails or is pulled out in a test or dug out for examination. Chance Engineers and field technicians have installed and pull tested all kinds of anchors all over the country to see what happens when heavy loads are applied. And here are the anchors they and that well known subterranean anchor expert, Mike the Mole, recommended for heavy transmission line guying.



CHANCE CROSS PLATE ANCHORS

Install in a single, vertical machine bored hole—drilled by the same bit used for boring pole holes. It installs in only half the time required to put down a log dead man—and will actually hold a much greater load ...70,000 pounds vs. 20,000 pounds for a creosoted log. (Test data on request.)

CHANCE NEVER-CREEP ANCHORS

When hole boring equipment can be used to drill holes at an angle—Choose the Never-Creep. It holds more "over the long pull" than any other type of anchor because it holds against solid earth in an inclined hole that is relatively unaffected by moisture seepage. Order these anchors from your Chance Distributor, or write A. B. Chance Company, Centralia, Missouri.

A·B·CHANCE CO· ABC INDUSTRIES

CA56-13

TECHNICAL LITERATURE

AIEE PUBLICATIONS—Following were issued recently by American Institute of Electrical Engineers, 33 W. 39 St, New York 18, N. Y. AIEE members are eligible for 50% discount on each:

Addendum to No. 1—General Principles upon which Temperature Limits Are Based in the Rating of Electric Machines and Other Equipment, 1 page, no charge.

No. 28B—Revised Report on Standards for Valve and Expulsion Type Lightning Arresters, 12 pages, no charge.

No. 58—Proposed Standard for Induction Motor Letter Symbols, 15 pages, no charge.

No. 59—Proposed Test Code for Metallic Rectifiers, 15 pages, no charge.

No. 552—Master Test Code for Electrical Measurements in Power Circuits, 40 pages, $1.20.

No. C39.1—Electric Indicating Instruments (Panel, Switchboard and Portable Instruments), 48 pages, $2.00.

No. C50.1—Synchronous Generators, Motors, and Machines in General, 46 pages, $1.80.

No. C50.2—AC Induction Motors, Machines in General, and Universal Motors, 31 pages, $1.30.

No. C50.4—DC Generators, Motors, and Commutating Machines in General, 33 pages, $1.50.

No. C50.5—Rotating Exciters for Synchronous Machines, 14 pages, $0.80.

No. C50.6—Motor-Generator Sets, 10 pages, $0.50.

No. C57.92—Guide for Loading Oil-Immersed Distribution and Power Transformers, 21 pages, $1.25.

No. C57.95—Guide for Loading Oil-Immersed Step-Voltage and Induction-Voltage Regulators, 15 pages, $1.00.

RELAYS—"Specifying Relays" is a 12-page technical article that covers various factors to be considered in selecting an electrical relay for a given application. These factors include circuit characteristics, type of switching, actuation power, operating speed, duty cycle, life expectancy, environmental conditions, physical requirements and cost. No charge, if request is on company letterhead. American Machine & Foundry Co, Public Relations Dept, 261 Madison Ave, New York 16, N. Y.

ZIRCONIUM FOR REACTORS—"Zirconium—Technology and Economics" is a 125-page report based on proceedings of a two-day meeting of Atomic Industrial Forum. The report includes papers on chemistry and production of metallic zirconium, fabrication, properties, corrosion behavior, alloys, supply of raw and refined materials, commercial products available, future AEC and industrial requirements. Price $3.00. Atomic Industrial Forum, Inc, 260 Madison Ave, New York 16, N. Y.

GRAPHITE FOR REACTORS—"The Production and Properties of Graphite for Reactors" is a paper presented at United Nations International Conference on Peaceful Uses of Atomic Energy at Geneva, Switzerland, Aug. 8-20, 1955. The 61-page book gives detailed information on production of artificial graphite in the electric furnace and the effects of raw materials and processing variations. Three chapters are devoted to the physical, mechanical and chemical properties. No charge, if request is on company letterhead. National Carbon Co, 30 E. 42 St, New York 17, N. Y.

BOOKS

Received Since April 17, 1956

Introduction to Electrical Engineering. By Walter LaPierre. Published by Harper & Brothers Publishers, 49 East 33rd Street, New York 16, N. Y. 339 pages, illustrated. Price $5.25.

Industrial Electricity, Vol. 1—Third Edition. By Chester L. Dawes. Published by McGraw-Hill Book Co, 330 W. 42nd St, New York 36, N. Y. 431 pages, illustrated. Price $5.50.

Analysis of Electric Circuits. By William H. Middendorf. Published by John Wiley & Sons, Inc., 440 4th Ave, New York 16, N. Y. 306 pages, illustrated. Price $6.00.

Proceedings, World Symposium on Applied Solar Energy. Sponsored by The Association for Applied Solar Energy, Stanford Research Institute, University of Arizona. Published by Stanford Research Institute, Menlo Park, Calif. 304 pages, illustrated. Price $5.00.

How to Make Clear Drawings

Engineering Drawing and Geometry. By Randolph P. Hoelscher and Clifford H. Springer. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, New York, 516 pages, illustrated. Price $8.00

Unusual breadth in its coverage of engineering drawing and basic descriptive geometry make this book outstanding. Not only does it cover adequately mechanical, architectural, structural and map drawing but also charts, diagrams and patent sketches.

This book was planned by its authors as a text for engineering students. Their aim was to make it understandable by freshmen but complete enough for two years of instruction, emphasizing reasoning and perception rather than skill alone. They have accomplished this objective fully and, in so doing, produced a book which should be used in many engineering offices as a reference.

Utility engineers, faced with extensive variety in the types of drawings and sketches they make, could profitably use this book as a guide.

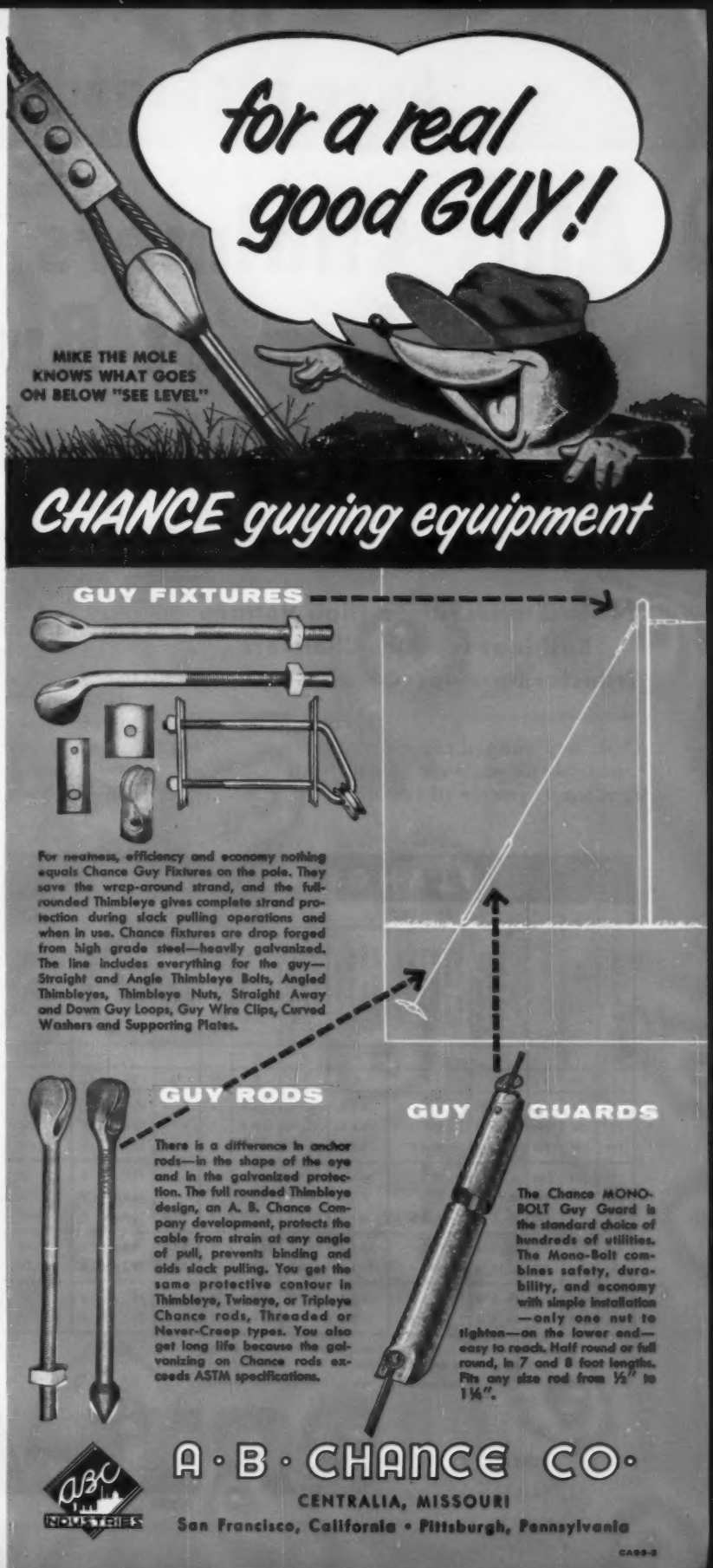
Protection for Power Systems

Selektivschutz. By H. Neugebauer. Published by Springer-Verlag, Reichpietschufer 20, Berlin W 35, Germany. 269 pages, illustrated. Price DM 28.50.

Written by an author with many years experience in selective protection on electric systems, this book traces the evolution of the basic concepts. Every new development, as he says, derives from past experience and crystallizes into a simple solution.

Some sections exhaustively covered in a 1936 edition have been included unchanged. But others have been condensed or omitted to provide space for new material. The result is a concise book involving only limited mathematics to promote an understanding of protection principles for

(*Continued on page* 218)


for a real good GUY!
MIKE THE MOLE KNOWS WHAT GOES ON BELOW "SEE LEVEL"
CHANCE guying equipment
GUY FIXTURES
For neatness, efficiency and economy nothing equals Chance Guy Fixtures on the pole. They save the wrap-around strand, and the full-rounded Thimbleye gives complete strand protection during slack pulling operations and when in use. Chance fixtures are drop forged from high grade steel—heavily galvanized. The line includes everything for the guy—Straight and Angle Thimbleye Bolts, Angled Thimbleyes, Thimbleye Nuts, Straight Away and Down Guy Loops, Guy Wire Clips, Curved Washers and Supporting Plates.
GUY RODS
There is a difference in anchor rods—in the shape of the eye and in the galvanized protection. The full rounded Thimbleye design, an A. B. Chance Company development, protects the cable from strain at any angle of pull, prevents binding and aids slack pulling. You get the same protective contour in Thimbleye, Twineye, or Tripleye Chance rods, Threaded or Never-Creep types. You also get long life because the galvanizing on Chance rods exceeds ASTM specifications.
GUY GUARDS
The Chance MONO-BOLT Guy Guard is the standard choice of hundreds of utilities. The Mono-Bolt combines safety, durability, and economy with simple installation—only one nut to tighten—on the lower end—easy to reach. Half round or full round, in 7 and 8 foot lengths. Fits any size rod from ½" to 1⅛".
A·B·CHANCE CO·
CENTRALIA, MISSOURI
San Francisco, California • Pittsburgh, Pennsylvania
ABC INDUSTRIES
CA56-8

Save Thousands of Dollars in

Allis-Chalmers Solves Problem of Bushing Interchangeability

...115 kv and above

Now Standardized High Voltage Bushings for Allis-Chalmers Transformers and Circuit Breakers

FOR any voltage class, one spare bushing is probably all you'll need for both Allis-Chalmers transformers and circuit breakers.

Think of what this will mean in savings in reduction of large idle bushing inventories.

Check the chart below for dimensional and rating information.

This is another example of Allis-Chalmers progress in Switchgear and Transformers.

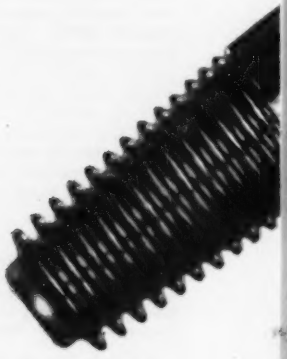
For details on how you can take advantage of this development, call your nearby A-C office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

FLANGE DETAIL

	Voltage Class, Kv	BIL	Current Amperes	LOWER END			FLANGE					TOP END TERMINAL	
							GASKET SPACE		PROVISION FOR BOLTS				
				Length of Bushing from Flange Seat to Lower End	Depth of Corr. Transf. Pocket. Distance from Bushing Gasket Surface to Min. Oil Level	Max. Diam. from 1" Below Flange to Lower End of Bushing	Inside Diameter Maximum	Outside Diameter Minimum	Number	Bolt Hole Size	Bolt Circle Diameter	Length	2-1/2" Useable Threads Class UNF-2A
				L	W	D	P	Q				A	R
	1	2	3	4	5	6	7	8	9	10	11	12	13
*	115	550	1600	42-15/16	23	9-1/2	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
*	115	550	1200	42-15/16	23	8-3/4	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
	115	550	800	46-11/16	26-3/4	8-3/4	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
*	138	650	1600	46-11/16	23	10-1/2	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
*	138	650	1200	46-11/16	23	9-3/4	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
	138	650	800	50- 7/16	26-3/4	9-3/4	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
*	161	750	1600	50- 3/16	23	11-1/2	12-3/8	14-3/8	8	1-1/4	15-3/4	3	2"-12
	161	750	800	53-15/16	26-3/4	11-1/2	12-3/8	14-3/8	8	1-1/4	15-3/4	3	2"-12
*	196	900	1600	59- 9/16	26-3/4	14-5/8	17-1/8	19-1/2	12	1-1/4	21	3	2"-12
	196	900	800	59- 9/16	26-3/4	14-5/8	17-1/8	19-1/2	12	1-1/4	21	3	2"-12

* Interchangeable between transformers and circuit breakers, suitable for draw leads at reduced current ratings.

NOTE: Oil gauge and capacitance tap are in line halfway between flange bolts.



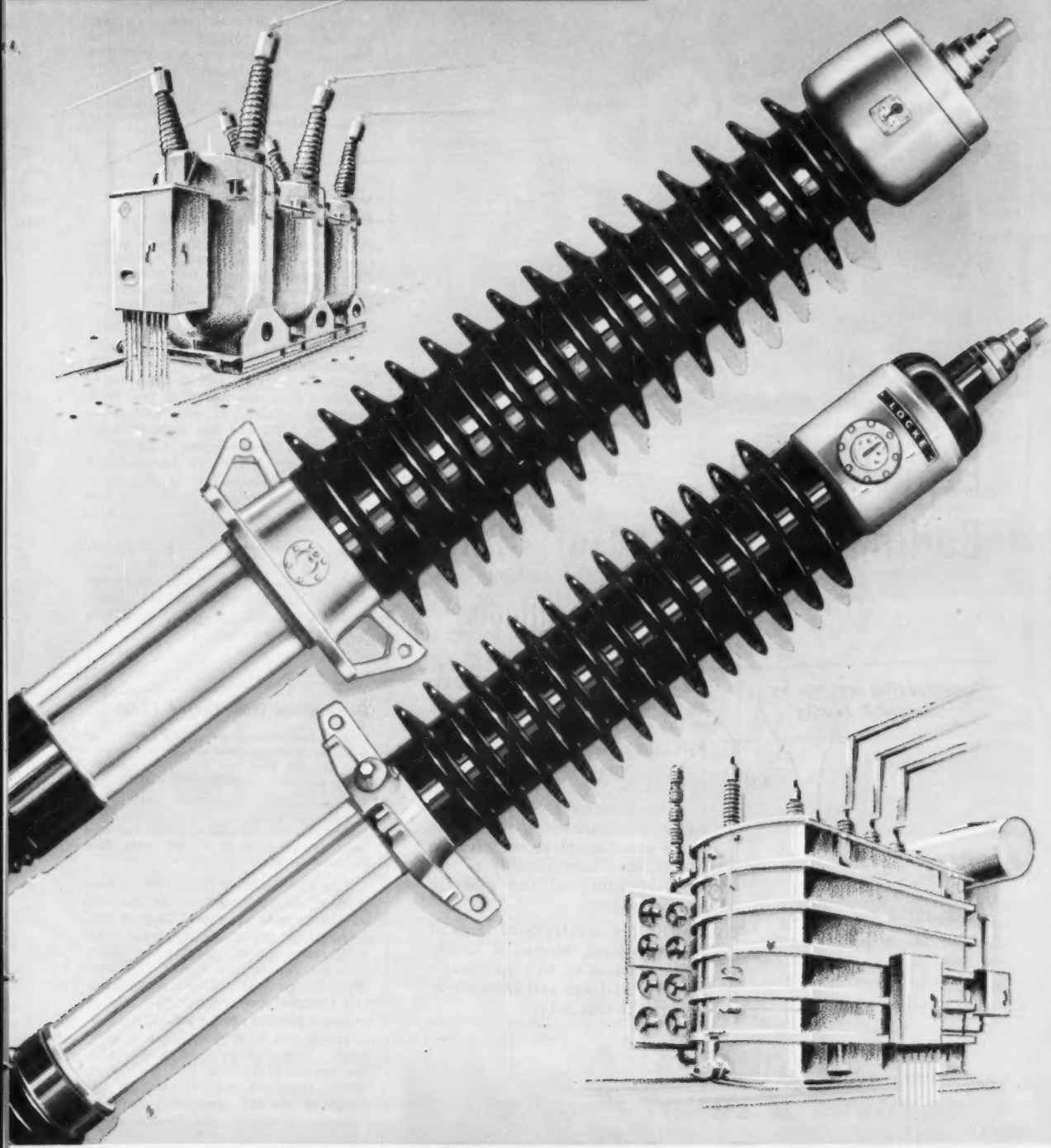
The problems of interchangeability have been worked out for both the Ohio Brass and Locke bushings, either of which can be furnished with Allis-Chalmers transformers and circuit breakers.

A-C ALLIS-CHALMERS

ALLIS-

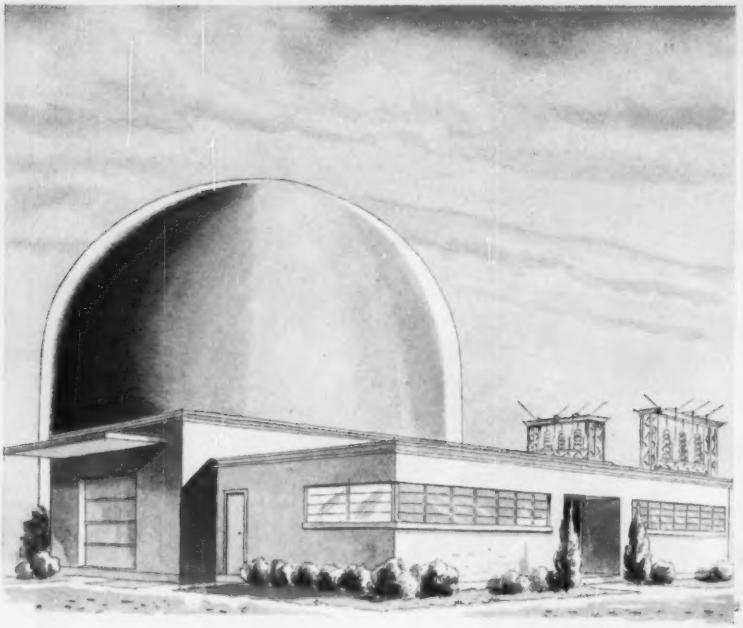
A-5092

Bushing Inventory



CHALMERS

LIVE BETTER ELECTRICALLY



Experimental
Boiling Water Reactor Plant
Argonne National Laboratory
Lemont, Illinois

engineering services by Sargent & Lundy

Scheduled for operation in early 1957

Throughout our 65 year history, Sargent & Lundy has been associated with many significant advances in the power industry.

From the time the country's first all turbine central station was designed in 1903 by Sargent & Lundy, the firm has continuously been active in the development of better and more economical steam electric plants, thus contributing to the high standing of the electric utility industry.

Now in the development years of nuclear power, Sargent & Lundy is responsive to this new engineering challenge and are actively engaged in this field.

SARGENT & LUNDY *Engineers*
140 South Dearborn Street
Chicago 3, Illinois

OUR 65th YEAR

Books

(*Continued from page* 215)

the power engineer or student.

American utility and equipment design engineers have shown renewed interest in German practices with the advent of EHV transmission. Study of this book could assist them in interpreting other European publications on this subject.

Who's Who in British Electrical Affairs

Electrical Who's Who 1956-57. Fourth Edition. Compiled by "Electrical Review." Published by Electrical Review Publications Ltd. Distributed by Iliffe and Sons Limited, Dorset House, Stamford St., London, S. E. 1. 458 pages. Price 21 shillings.

This reference book gives a brief biography of some 7,000 men and women in all branches of the British electrical industry and those in government departments which deal with electrical affairs. It was first published in 1950 and has been brought up to date in succeeding editions.

Each entry gives the position and previous appointments of the man listed. The entries are also classed as to companies and organizations in separate indices.

There is no counterpart to this book in the United States, although a number of electrical industry executives are listed in Who's Who, and some utility engineers are listed in Who's Who in Engineering.

Generation Has Varied Facets

Electric Generation—Steam Plants. Edited by B. G. A. Skrotzki. Published by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. 454 pages, illustrated. Price $8.50.

Electric Generation—Hydro, Diesel, and Gas Turbine Stations. Edited by B. G. A. Skrotzki. Published by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. 458 pages, illustrated. Price $8.50.

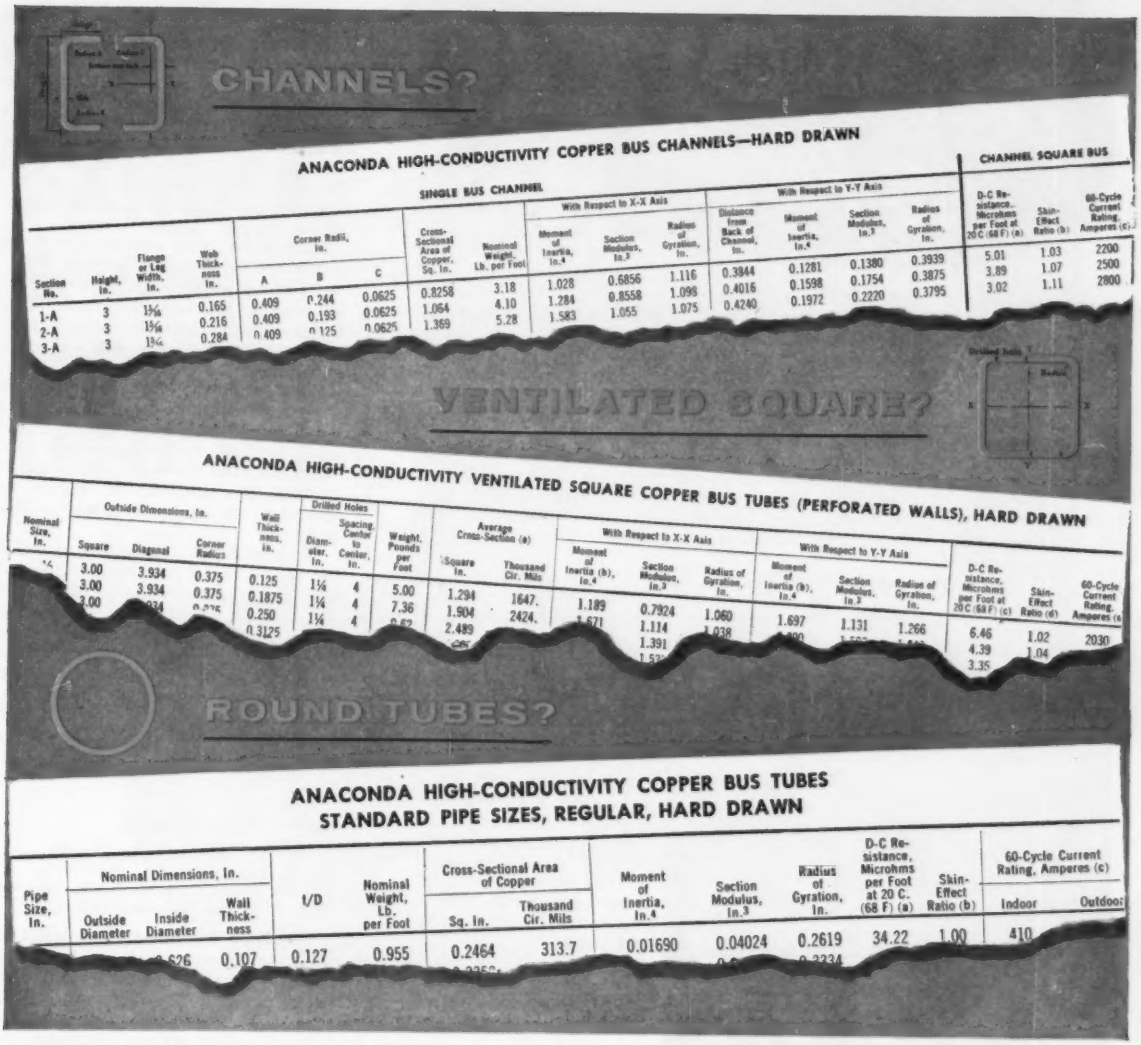
These books are written for the man without engineering training but who wishes to gain understanding of central-station systems. One book deals with steam power plants; the other, with central stations other than steam. Both are part of a four-volume Electric Utility Library which presents an over-all picture of the industry.

Treatment is elementary but thorough. The steam plant book takes the reader from coal pile to busbar. Other types of central stations are rendered similar treatment in their volume. Emphasis is on equipment although such things as heat cycles and control systems are presented.

Subjects are treated in a functional sequence. In the volume of steam plants this starts with fuel, fuel and ash handling, steam generators, pip-

(*Continued on page* 220)

Which Bus Shape for Your System?


CHANNELS?
ANACONDA HIGH-CONDUCTIVITY COPPER BUS CHANNELS—HARD DRAWN
SINGLE BUS CHANNEL
CHANNEL SQUARE BUS
VENTILATED SQUARE?
ANACONDA HIGH-CONDUCTIVITY VENTILATED SQUARE COPPER BUS TUBES (PERFORATED WALLS), HARD DRAWN
ROUND TUBES?
ANACONDA HIGH-CONDUCTIVITY COPPER BUS TUBES
STANDARD PIPE SIZES, REGULAR, HARD DRAWN

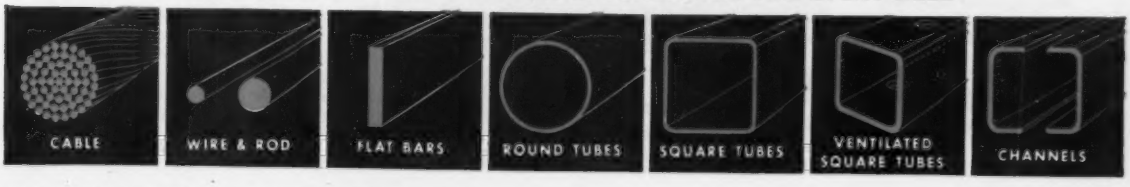
The table headings above are typical of the new information just published by The American Brass Company—to help make the selection of bus conductors easier and quicker. There are comparable tables for other rigid bus conductor shapes in the more commonly used sizes. In addition, convenient data is available for bare copper wire and cable and the most widely used Anaconda alloy wires.

For preliminary analysis—for many normal jobs—this new information can save you time, eliminate lengthy calculations. You'll find it in the brand-new Fifth Edition of The American Brass Company's 62-page Publication C-25, "Anaconda Copper for Electrical Conductors," which has much hitherto unpublished information to help you.

The services of The American Brass Company's Technical Department are available to help you in the solution of special problems involving the use of Anaconda Bus Conductors. For such help—or for a copy of "Anaconda Copper for Electrical Conductors"—see your nearby Anaconda representative. Or write: The American Brass Company, Waterbury 20, Conn. 5610A

ANACONDA® COPPER CONDUCTORS

THERE'S AN ANACONDA ELECTRICAL CONDUCTOR FOR EVERY NEED

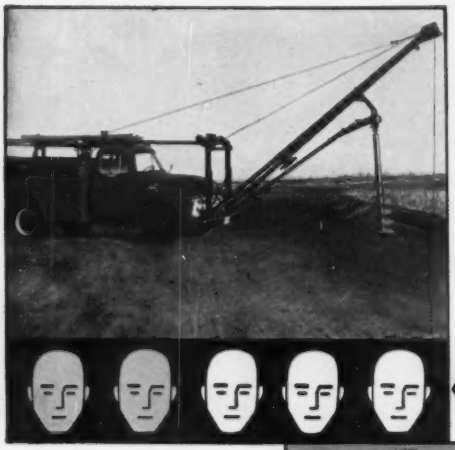


Convert Payrolls to Profits

Tel-E-Lect's complete line of front operated equipment now enables utility companies to do twice the amount of work with smaller crews in just half the time. If you're still using 5-man crews on obsolete utility equipment (even on a new chassis), you have extra men on the payroll that can be making a profit for you on another job. Tel-E-Lect builds the services of three men into its utility truck equipment. Now, *two men* can do the work once done by five!

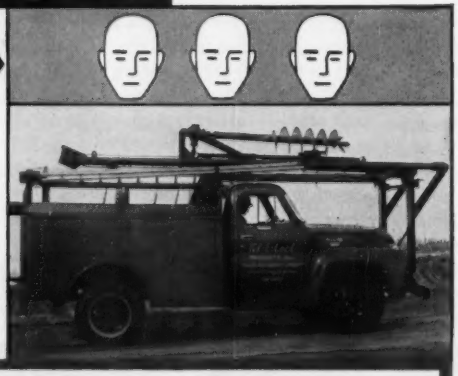
Adaptable to all makes of popular trucks, Tel-E-Lect quality-built front operated equipment is fast and versatile. The simplicity of operation of its winches, digger drive kits, FLD units, derricks, diggers and augers make them efficient and economical—require smaller crews to operate, thus freeing men for other jobs and for big, highline work.

After just *two minutes* on location, the digger and derrick are ready to go to work. Digger and derrick equipment are brought into working position by simply engaging winch line. The digger remains attached to the derrick and is raised or lowered by actuating a single lever in the cab. The load line is now available for pole setting. When digging in hard soil or frozen ground, the weight of the pole may be used as ballast for additional auger pressure.



Tel-E-Lect equipment saves three men out of five for other work.

These men are now available for other important jobs!



Compact, custom-built bodies and utility equipment by Tel-E-Lect are capable of handling the major portion of Telephone and Power Co. work. This unit is shown with derrick and digger stowed overhead for travel.

Write for literature on Front Operated Equipment

TEL-E-LECT PRODUCTS, INC.
10003 Minnetonka Blvd.
Minneapolis 26, Minnesota

Books

(*Continued from page* 218)

ing, steam turbines, condensers, feed water systems, water treatment, control, electric generation, and auxiliary systems and equipment. The last chapters discuss the equipment and advantages of supercritical pressure plants.

In the second volume over half of the material covers hydro installations. The remainder is devoted to internal-combustion engines with the exception of one chapter on gas turbines.

Book begins with a discussion of the water cycle and an elementary treatment of hydraulic principles. This is followed by material on dams, water turbines, and hydraulic-turbine generators. Section closes with a chapter on hydroelectric stations.

Chapters on the internal-combustion engines describe in detail the various components of this equipment. Plant operation and maintenance are also discussed. The closing chapter on gas turbines has material on theory of operation, turbine cycles, and equipment.

These books are highly recommended for the technical man without formal engineering education. Clearly written text with the abundant use of excellent demonstration-type illustrations makes self-study possible. They could also help the recently graduated engineer, by giving him a practical approach to apply his formal knowledge to a utility career.

Basic Circuit Theory

Electrical Circuits—Direct and Alternating Current. By Charles S. Siskind. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. 516 pages, illustrated. Price $6.75.

This book is primarily a college text for a two semester course in fundamental principles of electric and magnetic circuits. Its subject matter ranges from simple dc circuit theory through more intricate polyphase circuitry. Frequent cross references between ac and dc sections stress similarities and point out differences.

The author has succeeded in blending theory with practical application in each subject covered. Discussions progress logically from simple relationships to those of a more complex nature. They are based on actual circuit arrangements found in practical systems, devices and machines. Numerous examples of practical applications and operations are worked out to emphasis significant points. Mathematical derivations of formulas have been removed from the text proper and placed in an appendix.

The same features which will make this book a welcome text for college students will also make it valuable as a basic text for training electricians and other technicians. And graduate engineers will find it handy for quick reference.

DANGER SHUNS MODERN LIGHTING!

Modern lighting is safer, surer, with trouble-free WESTON control

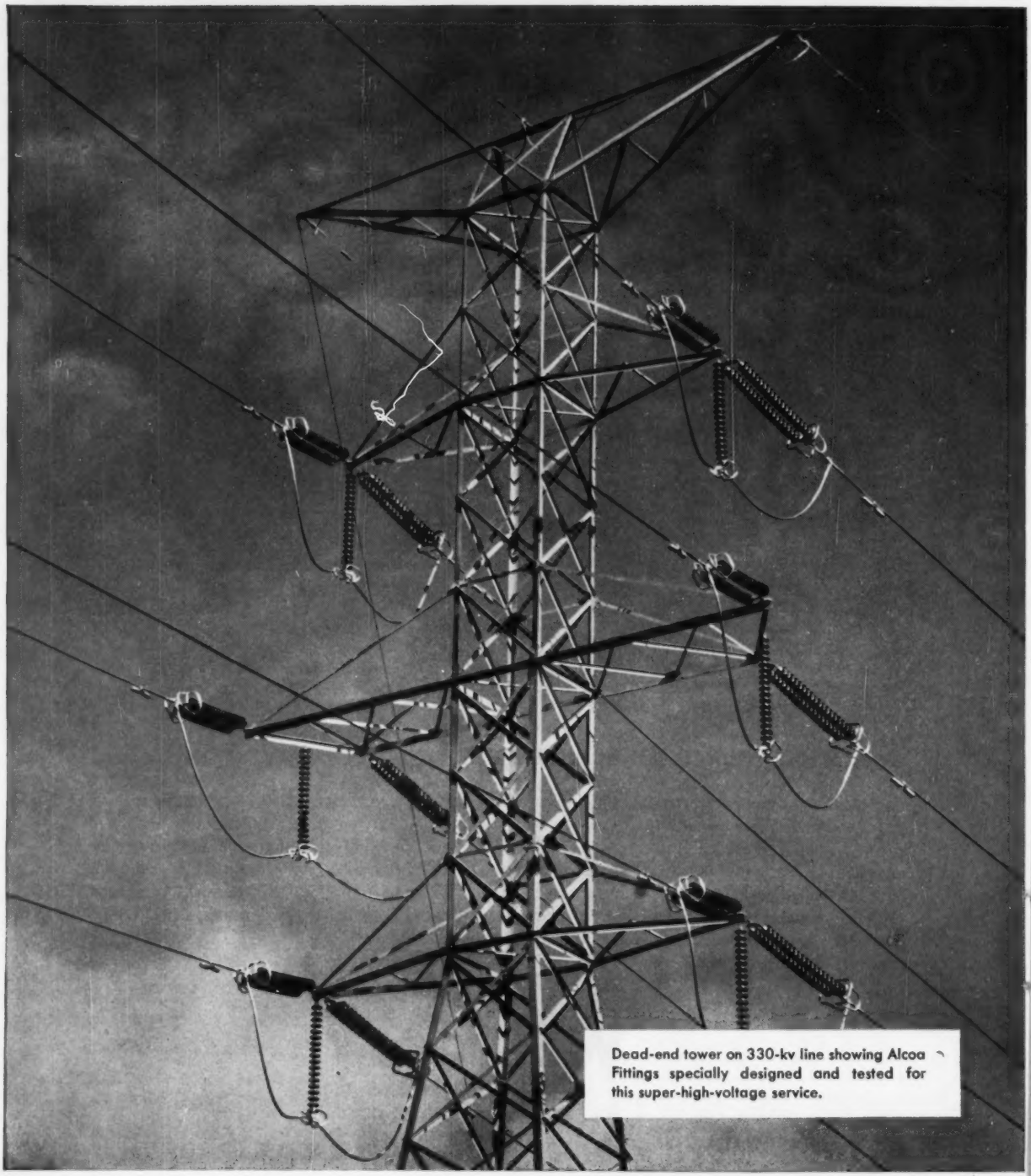
To make modern lighting installations fool-proof . . . to be sure beyond any question that lights are *on* whenever needed, and *off* only when *not* needed . . . more and more systems are installing the simplified WESTON plug-in Illumination Control. Employing only a few time tested components (no vacuum tubes, resistors or capacitors used) requiring no stand-by power, and with operating points unaffected by temperature, voltage, humidity or power failure, this simplified control provides unfailing operation over far longer periods. To get all the facts, call your local Weston representative, or write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J. A subsidiary of Daystrom, Incorporated.

WESTON

plug-in

ILLUMINATION CONTROL

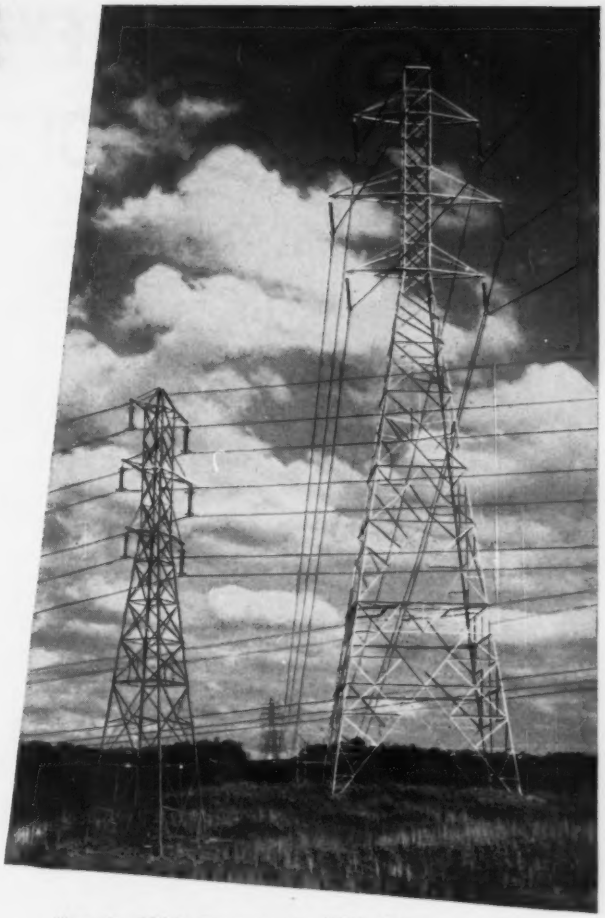
330-KV ALCOA EXPANDED ACSR LINES ON OHIO VALLEY ELECTRIC



Dead-end tower on 330-kv line showing Alcoa Fittings specially designed and tested for this super-high-voltage service.

NOW IN SERVICE SYSTEM

Diameter of 1.75 inches and high voltage set new mark for United States overhead conductor



Here the 330-kv line crosses a 138-kv line . . . constructed with Alcoa ACSR more than 30 years ago.

The nearly 400-mile double-circuit lines of the vast Ohio Valley Electric Corporation system, completed in 1955, set new records for United States overhead conductor: the rated voltage is 330-kv and the Alcoa® Expanded ACSR is 1.75 inches in diameter. Similar lines, totaling approximately 330 miles, are in operation on the American Gas and Electric system.

The fundamental research in electrical conductors that made these lines possible was begun by Alcoa more than 30 years ago. Projects in high-voltage aluminum conductors go on continuously in Alcoa's research division. This research division has kept pace with the progress of rapidly increasing loads, requiring larger central stations, higher voltage and bigger conductors. And, when the electrical industry is ready for even larger voltages, Alcoa will be ready with suitable conductors.

The same Alcoa Cable and Accessories, engineering personnel and production facilities that provided these 330-kv transmission lines are always at your service. When *you* have transmission problems calling for special conductor, bring them to Alcoa. No one is better equipped to help you solve them.

Just call your nearest Alcoa sales office. Or write Aluminum Company of America, 2306-E Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS
ALUMINUM COMPANY OF AMERICA
©ACOA

Always Use Aluminum Accessories With Aluminum Conductors

The ALCOA HOUR—Television's finest live drama—Alternate Sunday evenings

Shipments, Orders and Open Manufacturing Capacity for Electrical Equipment, 1955-1959

Total Capacity Shipped and on Order and Scheduled for Shipment	Shipped		On Order as of April 1, 1956					Total Scheduled for Shipment as of 4-1-56	New Capacity Scheduled 10-1-55 to 4-1-56	Capacity Shipped 10-1-55 to 4-1-56
	1955	First 3 Months of 1956	Last 9 Months of 1956	1956	1957	1958	1959 and Later			
LARGE STEAM TURBINE-GENERATORS[3] (10,000 Kw and Larger)[4]										
U. S. El Pwr Syst[1]	8,612,100	848,200	5,734,100	6,582,300	11,353,600	8,097,500	806,200	25,991,400	7,209,400	2,416,500
U. S. Industrials	91,800	12,500	540,600	553,100	1,230,200	.....	.....	1,770,800	759,200	59,300
Outside U. S.	472,600	262,500	479,600	742,100	285,000	331,200	.....	1,095,800	497,900	337,500
TOTAL	**9,176,500**	**1,123,200**	**6,754,300**	**7,877,500**	**12,868,800**	**8,428,700**	**806,200**	**28,858,000**	**8,466,500**	**2,813,300**
Est. Open Capacity[2]	.....	.....	.....	.....	400,000	6,500,000	15,000,000			
SMALL STEAM TURBINE-GENERATORS[3] (4,000 to 9,999 Kw)[4]										
U. S. El Pwr Syst[1]	65,600	31,200	114,100	145,300	16,900	.....	.....	131,000	13,500	46,800
U. S. Industrials	99,000	19,400	58,700	78,100	75,600	.....	.....	134,300	32,500	50,700
Outside U. S.	53,400	21,200	70,000	91,200	10,000	.....	.....	80,000	6,200	32,500
TOTAL	**218,000**	**71,800**	**242,800**	**314,600**	**102,500**	.....	.....	**345,300**	**52,200**	**130,000**
Est. Open Capacity[2]	.....	.....	.....	.....	700,000	1,200,000	1,200,000			
STEAM GENERATORS (450 Psi Pressure and Higher)[5]										
U. S. El Pwr Syst[1]	40,130	14,139	60,938	75,077	84,550	4,425	625	150,538	73,861	20,829
U. S. Industrials	9,448	4,102	15,321	19,423	9,930	.....	.....	25,251	18,767	8,184
Outside U. S.	7,269	3,459	11,543	15,002	4,045	.....	.....	15,588	7,503	6,341
TOTAL	**56,847**	**21,700**	**87,802**	**109,502**	**98,525**	**4,425**	**625**	**191,377**	**100,131**	**35,354**
Est. Open Capacity[2]	.....	.....	.....	.....	52,000	150,000	155,000			
STEAM GENERATORS (450 Psi Pressure and Higher)[6]										
U. S. El Pwr Syst[1]	47,008	16,474	71,289	87,763	98,223	5,234	727	175,473	87,377	23,805
U. S. Industrials	11,228	4,621	17,167	21,788	11,265	.....	.....	28,432	21,043	9,509
Outside U. S.	8,293	4,195	12,701	16,896	4,535	.....	.....	12,236	8,089	7,549
TOTAL	**66,529**	**25,290**	**101,157**	**126,447**	**114,023**	**5,234**	**727**	**221,141**	**116,509**	**40,863**
WATER WHEEL GENERATORS[7] (4,000 Kw and Larger)[4]										
U. S. El Pwr Syst	1,015,000	49,800	1,057,600	1,107,400	1,690,600	1,122,900	171,000	4,042,100	923,600	162,300
U. S. Industrials	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Outside U. S.	174,200	32,400	54,100	86,500	16,000	8,000	.....	78,100	41,200	116,400
TOTAL	**1,189,200**	**82,200**	**1,111,700**	**1,193,900**	**1,706,600**	**1,130,900**	**171,000**	**4,120,200**	**964,800**	**278,700**
Est. Open Capacity[2]	.....	.....	.....	.....	600,000	2,400,000	3,300,000			
HYDRAULIC TURBINES (5,000 Hp and Larger)[8]										
U. S. El Pwr Syst[1]	2,242,500	274,600	1,142,500	1,417,100	3,291,800	1,590,900	412,500	6,437,700	2,980,800	847,000
U. S. Industrials	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Outside U. S.	126,100	6,000	5,400	11,400	40,000	.....	.....	45,400	40,000	12,500
TOTAL	**2,368,600**	**280,600**	**1,147,900**	**1,428,500**	**3,331,800**	**1,590,900**	**412,500**	**6,483,100**	**3,020,800**	**859,500**
Est. Open Capacity[2]	.....	.....	.....	.....	1,000,000	3,000,000	4,100,000			
POWER TRANSFORMERS (501 Kva and Larger)[9]										
U. S. El Pwr Syst[1] and Indl	42,391,000	8,552,000	43,151,000	51,703,000	15,517,000	1,135,000	1,000	59,804,000	29,841,000	16,274,000
Outside U. S.	1,295,000	162,000	581,000	743,000	.....	.....	.....	581,000	196,000	242,000
TOTAL	**43,686,000**	**8,714,000**	**43,732,000**	**52,446,000**	**15,517,000**	**1,135,000**	**1,000**	**60,385,000**	**30,037,000**	**16,516,000**
Est. Open Capacity[2]	.....	.....	.....	9,000,000	57,000,000	72,000,000	74,000,000			

[1] U. S. Electric Power Systems. [2] Estimated open manufacturing capacity for production of additional units. [3] Manufacturers' max. rated capability.
[4] Figures in kilowatts. [5] Figures in 1,000 lb steam per hr. [6] Figures in heat output, millions Btu per hr. [7] Manufacturers' rating of generators.
[8] Figures in horsepower. [9] Figures in kilovolt-amperes.

Orders for Generating Capacity Hit Record

Five significant developments relating to large generating equipment brought out by the 19th Semi-Annual Electric Power Survey made by Edison Electric Institute are:

• Orders for steam and hydraulic turbine-generators placed during 1955 set a record of 20,270 Mw. This topped the previous record of 15,730 Mw in 1950.

• Orders for steam turbine-generators placed during 1955 totalled more than 18,500 Mw; another high, also topping above 15,730 Mw in 1950.

• Orders for steam generators in 1955 were also at a record high, totalling almost 102 million lb steam per hr. Previous record was in 1951, totalling 100 million lb steam per hr.

• Orders for steam generators in the first quarter of 1956 were close to a total output of 40 million lb steam per hr. If orders continue at this rate in 1956, total output of the units will be above 150 million lb steam per hr. Thus indications are that steam generator orders in 1956 will be another record high.

• Preponderant capacity of steam turbine-generators (100 Mw and above) installed in 1956 will be in the 100-149-Mw range; in 1958 the major capacity will be in the 150-199-Mw range.

Other outstanding facts developed are:

Largest turbine-generator in service to-date is a 260-Mw unit at Detroit Edison Co's River Rouge Station. Largest units ordered and included in the survey are two 335-Mw units for Consolidated Edison Co of N. Y., Inc, one for Astoria Station and other for Arthur Kill Station. And since the survey was completed, still larger units have been ordered—two 450-Mw turbine-generators for the American Gas & Electric System (EW, May 7, p 9).

Largest steam generator in service to-date is a 1.64-million lb-per-hr unit

(*Continued on page* 226)

NOW

BROWN BOVERI

NON-REGENERATIVE CYCLE GAS TURBINES

with 25% FIELD-TESTED EFFICIENCY

A 25,000 kW Brown Boveri Gas Turbine installed for Societa Selt Valdarno at Livorno, Italy, for peak load service using Bunker C oil. Proven tested efficiency of 25%. Non-regenerative cycle. Operating temperature on the gas side, 1200°F. insuring long life and low maintenance. Another identical unit goes into operation in May 1956.

WITH a proven-in-actual-operation efficiency of 25%, Brown Boveri Non-Regenerative Cycle Gas Turbines are setting new standards for performance and economy. This operating experience with large turbines — even those fired with low-grade gas or oil — can be found only in Brown Boveri Gas Turbines.

In first costs, these turbines show marked savings. They cost substantially less than comparable conventional steam turbine plants.

If you are concerned with large output gas turbines, it will pay you to investigate Brown Boveri equipment.

Other Recent Orders for identical 25,000 kW Brown Boveri Non-Regenerative Cycle GAS TURBINES

- **Societa Romana di Electtricita for Roma 1 (Italy) Power Station**
- **Gullspong Munksfors Kraft AB Oerebro for Otterbacken Power Station**
- **City of Edmonton, Canada, Power Plant, 2 units**
- **City of Vancouver, Canada, Power Plant, 3 units**
- **City of Jearcan, Canada, Power Plant, 1 unit**

BROWN BOVERI

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Butte, Mont. • Chicago, Ill. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • Hamilton, O. • High Point, N. C. • Houston, Tex. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Lewiston, Me. • Miami, Fla. • Minneapolis, Minn. New Orleans, La. • New York, N. Y. • Pasadena, Cal. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • Seattle, Wash. • Syracuse, N. Y. • Tucson, Ariz.

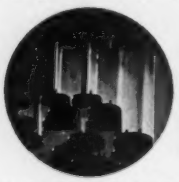
Ask these questions, too, when you judge a fluorescent lamp...

Are its electrodes built for longest lamp life?

Constant development of new and better ways to make fluorescent lamp electrodes has enabled Westinghouse to *triple* the life of its fluorescent lamps since 1948.

Is it easy to seat securely?

Westinghouse fluorescent lamps are built with "guide bumps" on the end-caps. Easily felt with the fingers during lamp installation, they tell at a touch when the lamp has been securely seated in its sockets.



Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative. "You can be sure if it's Westinghouse."

WATCH WESTINGHOUSE

WHERE BIG THINGS ARE HAPPENING FOR YOU

Generating Capacity

(*Continued from page* 224)

at River Rouge Station. Largest on order are two units, each rated 2.4-million lb per hr, for Consolidated Edison's Astoria and Arthur Kill Stations (EW, July 18, 1955, p 56). Steam generators for the AG&E 450-Mw turbine-generators were not on order when this survey was completed.

Steam generators rated on a Btu-per-hr basis have an 18% higher rating than on the lb-per-hr basis for orders during the 6-month period, Oct. 1, 1955-April 1, 1956. The increased rating is due to high pressures, temperatures, and other performance characteristics.

Steam turbine-generators for three nuclear reactors for U. S. electric power systems were on order April 1. Combined capacity is approximately 430 Mw. The turbine-generators are: **1.** Duquesne Light Co's 100-Mw unit which is scheduled for operation by 1958, **2.** a 180-Mw unit for Commonwealth Edison Co, scheduled for operation about 1960, and **3.** a 150-Mw unit for Pennsylvania Power & Light Co, which is expected to be in operation by 1962.

Following information on production, shipments, and new orders are only for U. S. electric power systems. These data are from the table on page 224 and elsewhere in the 19th survey.

Production . . . Electric generating equipment (4 Mw and larger), thermal and hydraulic, scheduled for production in 1956 totals about 7,800 Mw. This amount is 1,870 Mw lower than the shipments in 1955. Major decrease is in the thermal generating units.

Scheduled production of thermal and hydraulic generating capacity in 1957 (based on April 1, 1956, data) totals over 13,000 Mw, in 1958 about 9,220 Mw, and in 1959 and later about 977 Mw. The 1957 value is about an 80% increase over the value reported a year ago.

Power transformers scheduled for production in 1956 have a total of 51,703 Mva. This capacity is an increase of 9,312 Mva or 22% over the 42,391 Mva shipped in 1955.

Shipments . . . For the first quarter of 1956 shipments of steam turbine-generators (10 Mw and larger) were 848 Mw or about 1,700 Mw less than for the same period in 1955. Low shipments are reflected by lack of orders in 1953 and 1954. Slippage in shipment occurred on 7 units, totalling 760 Mw in the last quarter of 1955.

Steam generator shipments in the six months, Oct. 1, 1955-April 1, 1956, totalled 20,829,000 lb steam per hr. This is an 18% decrease from 25,438,000 lb per hr for the same period a year previous.

Power transformer shipments in the six months prior to April 1, 1956, totalled 16,274 Mva. This is 55% of the new orders placed during the same period.

New Orders . . . During first quarter of 1956 new orders for steam turbine-generators amounted to 2,117 Mw, plus the waterwheel generators of 915 Mw, or a total of 3,032 Mw.

New thermal and water-wheel generator capacity during the six-month period, Oct. 1, 1955-April 1, 1956, totalled 8,147 Mw. This amount is a 25% decrease from 10,801 Mw for the similar period in 1954-1955.

For large steam turbine-generators (10 Mw and larger) new orders placed from Oct. 1, 1955, to April 1, 1956, totalled about 7,209 Mw, a 21% decrease from 9,074 Mw during the same period a year ago.

Water-wheel generator capacity of 924 Mw was ordered during the six months prior to April 1, 1956. This capacity is 45% less than 1,669 Mw ordered during the same period a year previous.

Steam generators ordered in the Oct. 1, 1955-April 1, 1956 period have a total output of 73,861,000 lb steam per hr. This output is 113% increase from 34,684,000 lb per hr for the similar 1954-1955 period.

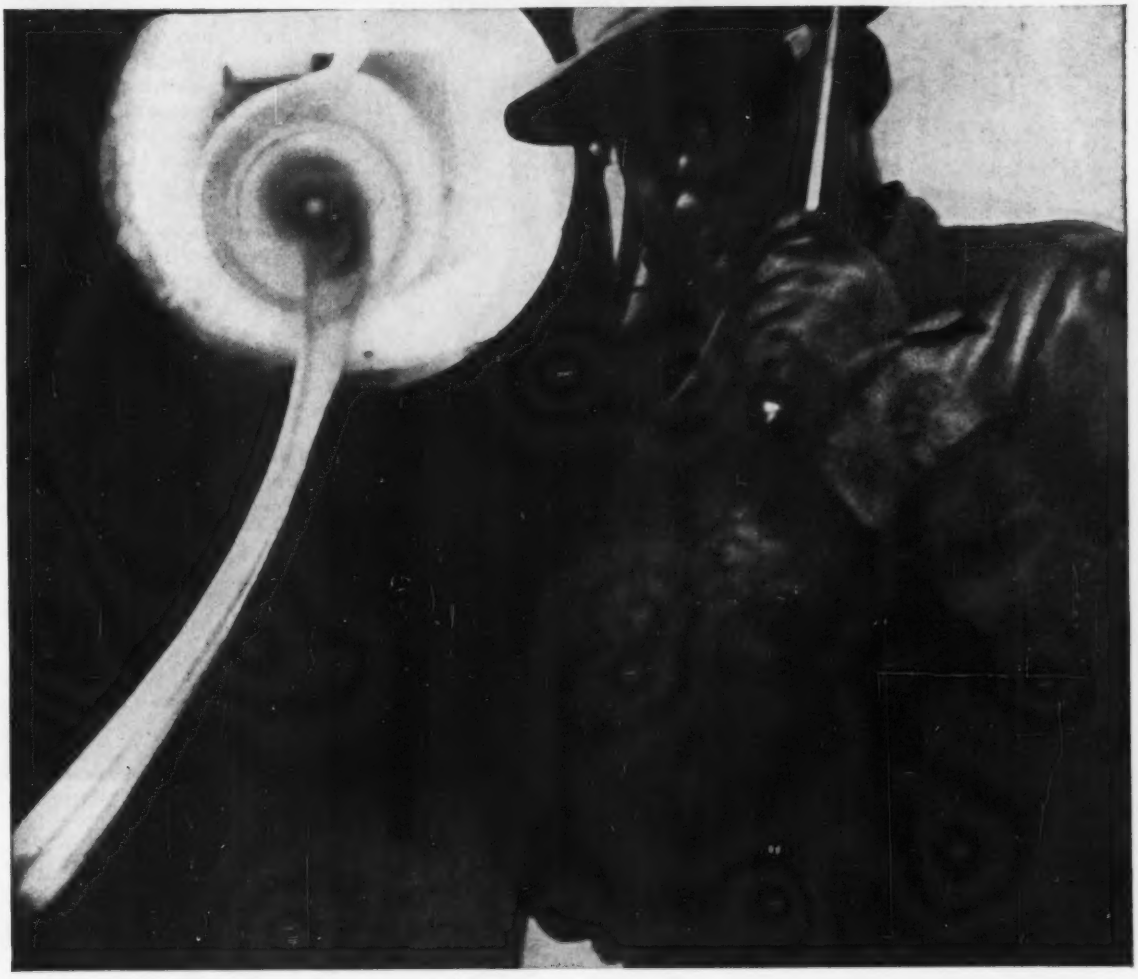
The record indicates that on April 1, 1956, approximately 4,000 Mw of new generating capacity was on order for U. S. electric utilities for which steam generators had not been ordered. Boilers are often ordered about six months after the electric units probably because of the shorter manufacturing cycle for the steam generating units.

Power transformers during the six months, Oct. 1-April 1, totalled 29,841 Mva. This capacity is a 24% increase from 24,120 Mva for the corresponding six months in 1954-1955.

The EEI survey covers steam turbine-generators, steam generators,

(*Continued on page* 228)

how to judge a fluorescent lamp . . . point no. 3



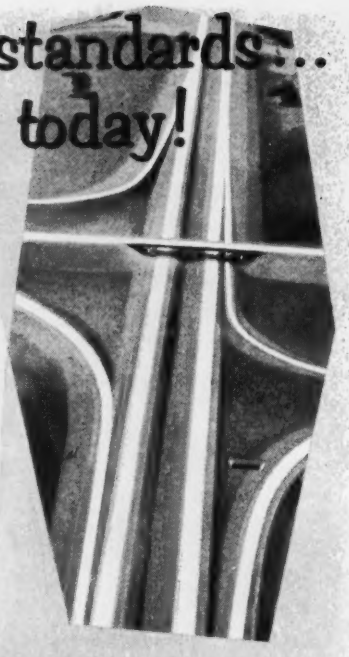
ask about TAILORED GLASS

Quality of glass in a fluorescent lamp directly affects lamp performance. For example: if the "surface condition" of the glass is not exactly right, the lamp's light-producing phosphor coating will not stick securely to the inside of the tube, and bare spots will develop. To make *sure* of proper surface condition—as well as high strength, good clarity, precise dimensions and other essential properties—Westinghouse makes all of its own fluorescent lamp glass, tailoring it from silica to finished tubing specifically for fluorescent service. "You can be sure if it's Westinghouse."

WATCH WESTINGHOUSE

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

tomorrow's standards... today!



The Ohio Turnpike is the newest link in a national chain of superhighways that will eventually tie East to West. The most modern concepts of traffic engineering are reflected in the construction of this magnificent road. What transformers are used for service and lighting? Marcus, of course!

Electrical contractors:
Amon Electric Co., Warren, Ohio
Peterson-Webster Electric Co.
Youngstown, Ohio

MTC

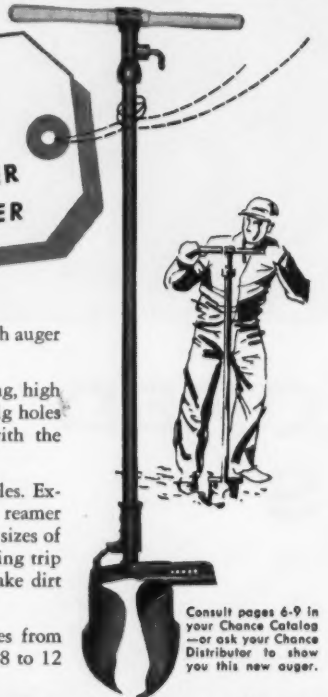
Marcus TRANSFORMER CO., Inc.
RAHWAY, NEW JERSEY

"Mark of Quality"

Representatives in Principal Cities

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

THIS NEW
CHANCE
TELESCOPING TRIP AUGER
DIGS HOLES 20% FASTER



Here's a completely new, ruggedly built earth auger —especially designed for line work.

Due to the particular design of its fast cutting, high strength blades our linemen were able to dig holes 20% faster with this new auger than with the previous model.

The handle telescopes for digging deep holes. Extension rod locks at 6-inch intervals. The reamer blade can be expanded and set to bore nine sizes of holes with the same auger. A smooth working trip mechanism opens the movable blade to make dirt dumping easy.

Five models are available for digging holes from 6½ to 14⅜ inches in diameter, and from 8 to 12 feet deep.

Consult pages 6-9 in your Chance Catalog —or ask your Chance Distributor to show you this new auger.

CT56-14

A·B·CHANCE CO·
CENTRALIA, MISSOURI,

(*Continued from page* 226)

water-wheel generators, hydraulic turbines, and power transformers. Data are compiled as of April 1, 1956, and relate to shipments, scheduled production and estimated open manufacturing capacities for 1956 through 1959. Information was furnished by 19 of the country's leading manufacturers of heavy electric power equipment. Data on steam turbine-generators are based on manufacturers' maximum rated capability, and the other equipments on nameplate ratings.

For data relating to peak and reserve capacity developed by the survey see page 116.

M&M BRIEFS

Atomic Energy Commission will have new headquarters near Germantown, Md. The 400,000-sq ft building will be located on a 109-acre site. John McShain, Inc, of Philadelphia, Pa., was awarded the contract for $8,828,900 for construction of the building. Scheduled completion date is late 1957.

Westinghouse Electric Corp's Sturtevant Division recently won National Safety Council's top award for 1955 record. Injury frequency rate was 71% better than Council's computed "par" and injury severity 30% better.

M. W. Kellogg Co has consolidated its New York offices at 711 Third Ave, New York 17, N. Y.

Alco Products, Inc, of Schenectady, N. Y., received a $859,826 contract for construction of 34 diversion tunnel gates for the St. Lawrence River power project. Delivery is scheduled to begin in May, 1957, and to be completed in four months. The gates will consist of steel weldments and be about 21 ft high and 16 ft wide.

Alvin D. Palmer of Oak Park, Ill., has developed a tree-trimming tape for cables. This tape has a rough aggregate coating of silicon carbide on its outer surface. When the tape is wrapped on a cable or service drop, action by the wind will cause a sawing motion. This cuts new tender shoots, and a clearance is maintained.

DOW

GIVE HIM THE RIGHT TOOLS FOR THIS JOB!

DOW WEED AND BRUSH KILLERS provide an effective, money-saving vegetation control program.

Ask the men who man the axes. Brush and weed control is tough and tedious. And manpower is worth money today! Check the figures—cutting is a time-consuming, reoccurring and costly expense.

Better Control With Chemicals

Sure, you've got to keep right-of-ways clear—to minimize service interruptions, outages, reduce fire hazards and to guard the safety of repair crews. But give the crew the right tools to work with—Dow weed and brush killers.

Investigate Dow programming—the proper use of the right chemical specifically designed to control problem species in your area. Dow herbicides give better kill, control regrowth longer—at lower costs.

Special Chemicals for Brush, Grass

Try Esteron® 245, Kuron® or Esteron Brush Killer on trees or brush. Available for use with either petroleum or water carriers. They combine hard-hitting power with low drift, low toxicity qualities. Try Radapon*, containing dalapon sodium salt, the amazing systemic grass killer.

BARON—Complete Weed Control

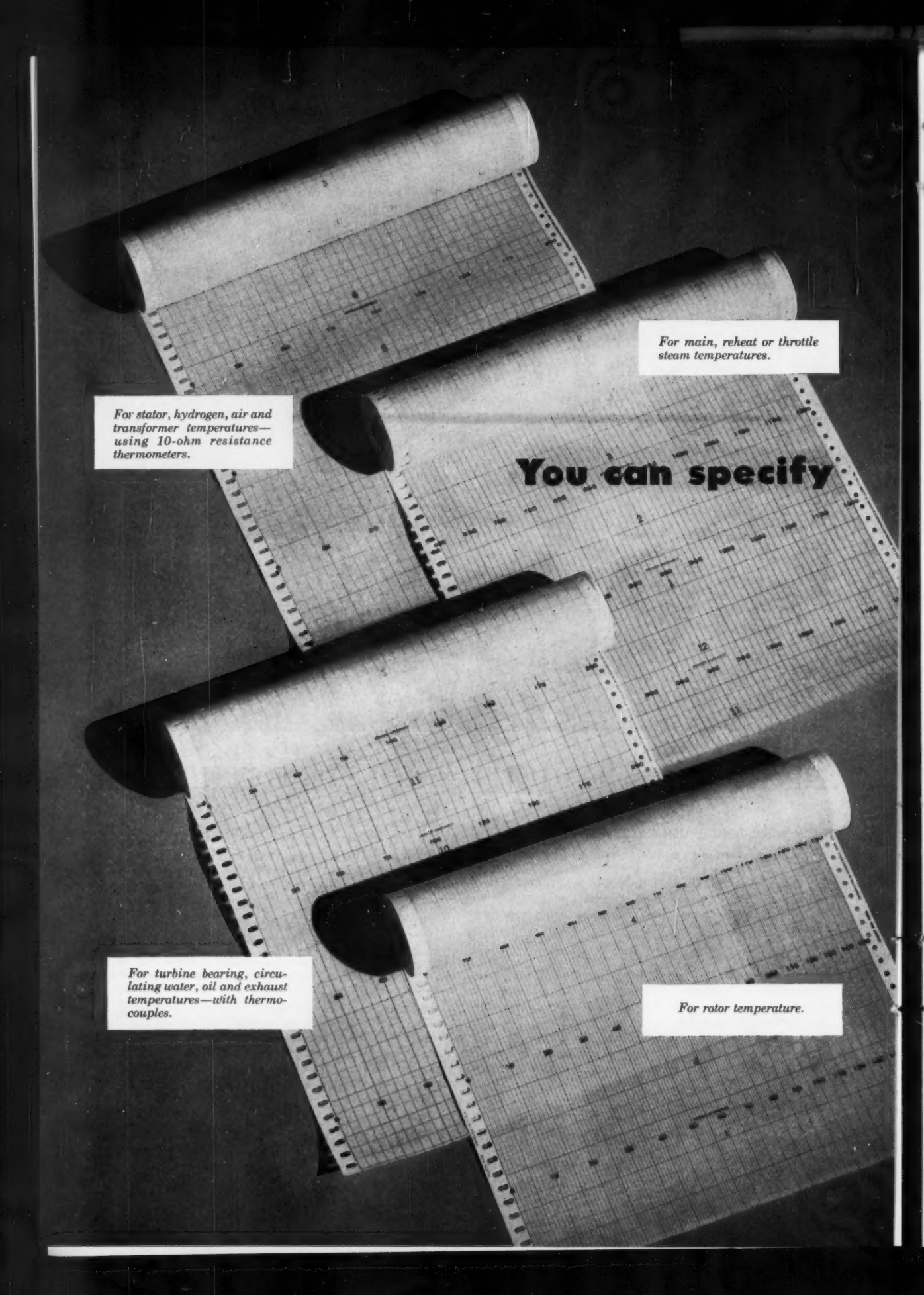
Use Baron*, a semisterilant for control of broad and narrow-leaved weeds. It is ideal for use around substations, storage areas and plant sites.

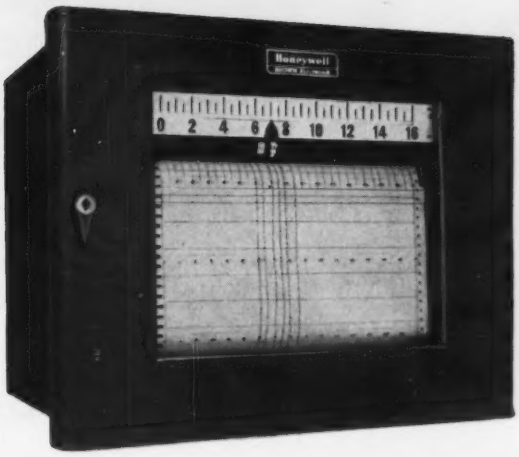
Application techniques are simple—your own crew can do the job—or we'll be happy to recommend a custom applicator near you. We'll be glad to send cost figures showing how other people saved money by using Dow selective herbicides. Write THE DOW CHEMICAL COMPANY, Industrial Section, Agricultural Chemical Sales Department, Midland, Michigan.

*Trademark of The Dow Chemical Company

you can depend on DOW AGRICULTURAL CHEMICALS

DOW


You can specify
For main, reheat or throttle steam temperatures.
For stator, hydrogen, air and transformer temperatures—using 10-ohm resistance thermometers.
For turbine bearing, circulating water, oil and exhaust temperatures—with thermocouples.
For rotor temperature.



ElectroniK strip chart recorders can be supplied for power plant use with scores of different temperature calibrations. Some of the typical standard charts are shown on the opposite page. Actual chart size is 11 inches in calibrated width.

an *ElectroniK* recorder ... for any of your temperature measurements

GENERATOR stators and rotors, coolers, transformers, bearings, oil ... steam headers, reheat steam, throttle steam ... all require precise and reliable temperature measurement.

The accurate, efficient way to keep constant watch over any or all of these is to use *ElectroniK* recorders. A broad variety of standard calibrations is available to work with thermocouples, standard 10-ohm copper resistance thermometers; or, for rotor temperatures, with the individual rotor winding. Numerous ranges cover all the temperatures encountered in modern power plant practice.

You can select models which record a single temperature, or which combine from two to twenty related temperatures on a single chart for simplified correlation. On the 11-inch wide charts, operators can spot trends in accurate detail ... engineers can analyze operation readily. Daily chart sections are easily removed for filing.

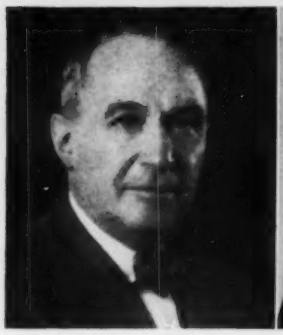
Instruments can be supplied with built-in circuits to actuate signals and annunciators to warn of excess temperatures. And to work with these recorders, Honeywell supplies a comprehensive line of thermocouples, extension wires and resistance thermometer elements designed for power plant applications.

ElectroniK instruments are famous for their ability to stay on the job with minimum attention. This characteristic has been proved in thousands of industrial installations, including many of the country's leading power plants. For a discussion of how they can be applied to your plant temperature measurements, call your local Honeywell sales engineer ... he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa. — in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for Bulletin 9070, "Instruments for Electrical Power Generation."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



A. M. BEEBEE

R. E. GINNA

R. H. McCUMBER

L. B. BOWMAN

RG&E Advances 4 Executives to Top Posts

Alexander M. Beebee, president of Rochester Gas & Electric Corp since 1947, has been elected chairman of the board and chief executive officer, and Robert E. Ginna, executive vice president since 1950, has been elected president. In other executive changes, Ralph H. McCumber and Linn B. Bowman were named to the newly created posts of vice president of electric and steam and vice president of gas and transportation, respectively.

A Cornell University graduate, Beebe joined RG&E in 1916 and became general superintendent, Gas Division, in 1927, and vice president in 1945.

Ginna, who came to RG&E after 12 years in the consulting engineering field, served a number of years as manager of the rate and contract department. He was appointed vice president of the utiilty in 1945.

McCumber, general manager of electric and steam operations since 1949, formerly held posts of superintendent of steam heating plants and superintendent of electric generation.

A 31-year veteran of RG&E, Bowman became general superintendent of the Gas Division in 1950 and general manager of the gas and transportation departments in 1952.

KP&L Elevates D. E. Ackers, B. S. Jeffrey

D. E. ACKERS

New chairman and chief executive of Kansas Power & Light Co is Dean E. Ackers. He is succeeded as president by Balfour S. Jeffrey, formerly assistant president.

Ackers, president since 1934, began his career with KP&L in 1920 as operating engineer. Since then he has served in various capacities, including Topeka district manager, assistant general manager, general manager, and vice president.

Before joining the utility in 1953 as assistant president, Jeffrey was with Doran, Kline, Cosgrove, Jeffrey & Russell, a Topeka law firm which has served KP&L for 38 years.

B. S. JEFFREY

E. J. DWYER

ESB Elects Dwyer Vice President

Electric Storage Battery Co has announced the election of E. J. Dwyer as vice president of the company. In addition to his vice presidential duties Dwyer will continue as secretary.

He joined ESB in 1948 as assistant secretary, directing the company's legal department and its stockholder relations. In August 1954 he was promoted to secretary, and the following January was elected to the board of directors. Dwyer is also secretary and a director of ESB International Corp and Jessall Plastics, Inc, and secretary of Exide Batteries of Canada, Ltd, subsidiaries.

Recommended for LOW MOUNTING HEIGHTS

HOLOPHANE REFLECTORS

with MERCURY LAMPS

NEW!

For the Best Lighting of Plant Low-Bay Areas

•

Holophane Unit 635-AL

- ***Deep-Shielded Glareless Illumination***
- ***High Output from Long Life Sources***
- ***Low Operating and Maintenance Costs***

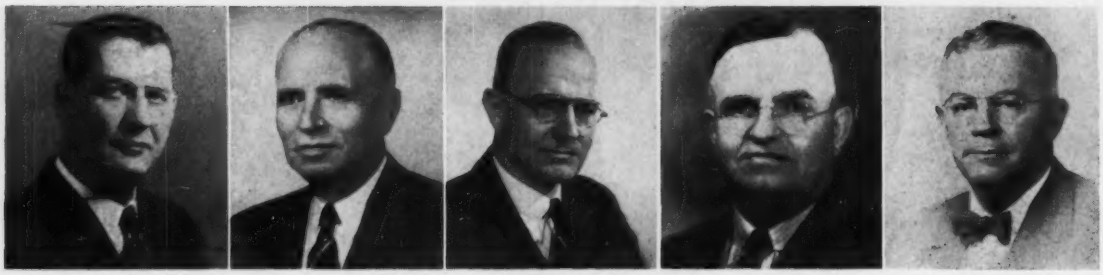
Photos Shown: (Above) Wolverine Tube Division of Calumet & Hecla, Inc.; (Below) Kaiser Aluminum and Chemical Co.

For Better Lighting Holophane *Be Specific*

Holophane research has perfected an entirely new and practical approach for illuminating industrial interiors with low mounting heights. The new unit, 635-AL, designed for mercury vapor lamps has proved highly efficient in a wide range of low bay applications. In some of these, the ceiling is as low as 12 feet above the floor, 9 feet above the work plane . . . The unit consists of a metal-covered prismatic glass reflector assembly and ventilated socket housing. Its outstanding features are deep shielding and high outputs in useful lumen zones. The open bottom assures easy maintenance and simple lamp replacement . . . Write for complete engineering data; no obligation.

HOLOPHANE

HOLOPHANE COMPANY, INC.
Lighting Authorities Since 1898
342 Madison Ave., New York 17, N.Y.
THE HOLOPHANE CO., LTD., THE QUEENSWAY, TORONTO 14, ONTARIO



H. E. BAKKEN | J. P. HAIGHT | L. LITCHFIELD, JR | R. T. WHITZEL | E. B. WILBER

Five Vice Presidents Appointed by Alcoa

Recently elected vice presidents of Aluminum Co of America were H. E. Bakken, general manager, refining division; J. P. Haight, chief engineer; Lawrence Litchfield, Jr, general manager, mining division; R. T. Whitzel, general production manager; and Edward B. Wilber, treasurer.

Bakken joined Alcoa in 1919 and in 1926 became manager, American Magnesium Co, a subsidiary. He later became vice president-general-manager, Aluminum Ore Co, and refining division assistant general manager.

Haight, a 36-year veteran, has served as chief engineer, works manager, fabricating division manager, and chief engineer.

Litchfield joined Alcoa in 1925 and served in engineering posts overseas. He was named Alcoa Mining Co president in 1952.

Whitzel came to Alcoa in 1915, and after various managerial posts, was named smelting division general manager in 1952.

Wilber has held various sales posts since he joined in 1920, including resident sales manager and manager of pig and ingot sales.

Hughes Named Pepco Engineer

Potomac Electric Power Co has appointed Dorsey F. Hughes as electrical engineer to succeed Lucius E. Steere, Jr, who retired May 1.

As chief engineer Hughes will assume responsibility for the administration of the electrical engineering and system planning activities of the company. Since he began his employment at Pepco in 1934 Hughes has served continuously in the distribution engineering division of the company, with the exception of a short time when he served as assistant to the manager of the electric system.

D. F. HUGHES

PERSONAL BRIEFS

J. Ralph Hanford has been promoted from assistant division superintendent, New Brunswick area, electric distribution department of Public Service Electric & Gas Co, N. J., to safety engineer, electric department. He succeeds **A. F. Randolph,** who retires after 45 years with the company. **George H. Barnstorf** moves up from division meter engineer, Elizabeth area, to replace Hanford; and **Kenneth G. Limmer,** former assistant engineer, succeeds Barnstorf.

E. A. Casey's promotion from personnel manager of the power department to manager of union relations is one of three advancements in West Penn Power Co's general office staff at Greenburg, Pa. Others elevated are **Ralph H. Miller,** to general claim agent, and **Charles H. Adams** to supervisor of real estate.

Georgia Power Co has named **Hoyt A. Wiggins** assistant division superintendent of its Atlanta Division.

Northwestern Utilities, Ltd., has designated **Murray E. Stewart** as assistant general manager. He previously served as superintendent of technical services and assistant to the general manager.

New president of White Motor Co is **J. N. Bauman,** executive vice president in charge of the White Truck Division since last year. He succeeds **Robert F. Black,** who now becomes chairman and chief executive officer.

William Knutz, electrical engineer in Northern Indiana Public Service Co's general engineering department, Hammond, has retired following 32 years of continuous service.

H. M. Harper Co has announced the election of **H. M. Harper, Jr,** to the position of secretary of the company.

OBITUARY

Bernard S. Rodey, Jr, 62, an officer of Consolidated Edison Co of New York, Inc, and manager of the company's tax department since 1946, died recently in East Williston, Long Island, N. Y. He was co-author of a textbook, "Public Utility Accounting."

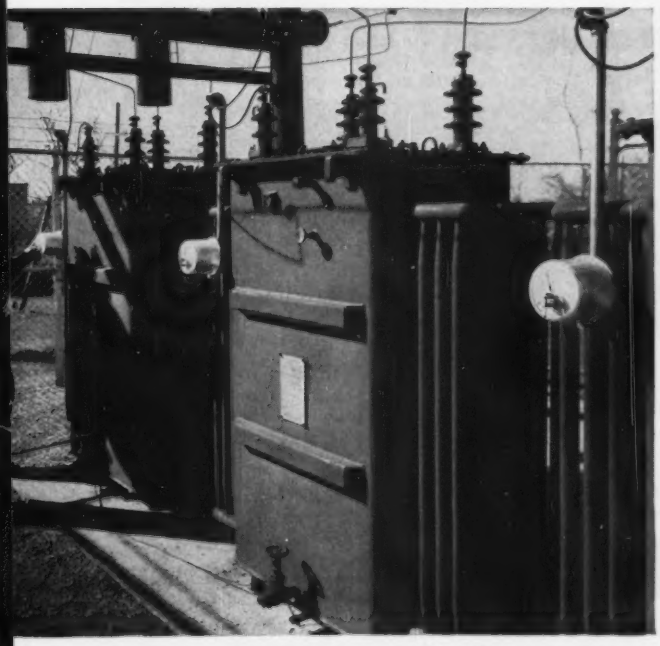
A V2JS VOLTMETER-WATTHOUR METER COMBINATION permanently installed at first or last customer from the transformer. Regular meter reader reports minimum and maximum voltage to Engineering Department.

COMPLETE TEST SET checks load and voltage at customer's premises —gives full information on circuit conditions at input to customer service, while continuing to record KWH consumption.

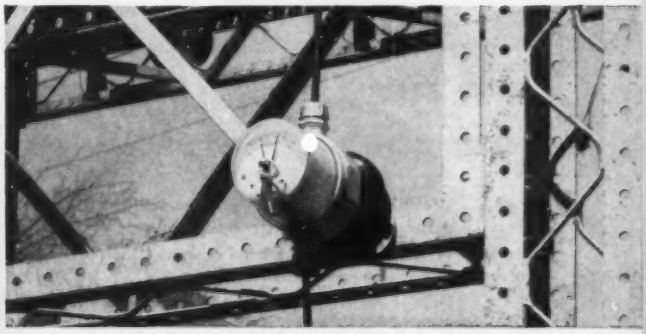
for better knowledge of your system ...use Lincoln Meters!

Indicating meters provide the low-cost way of obtaining complete knowledge of your system. They give continuous data of load, balance, and current values—on transformers, on feeders, at substations, at system check points. Lincoln Indicating Meters are simple in design and operation—flexible in application. Use the coupon below for detailed information on these economical aids to system betterment.

SANGAMO ELECTRIC COMPANY, Springfield, Illinois



LINCOLN ADN AMPERE DEMAND METERS, tied solidly in to the neutral, provide continuous knowledge of load and balance on 4WY banks of transformers. No instrument transformers are required.



THIS "HOT" TYPE AD-5 LINCOLN METER indicates amperes and gives balance on primary feeder circuits. Meter is insulated from ground with a post-type insulator and is arranged for hot stick reset.

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

Please send me the information checked below:

- ☐ Information on Lincoln Voltmeters and Ammeters.
- ☐ Bulletin on Test Sockets.
- ☐ Booklet: "Solving Distribution Problems through Measurement."

NAME_____

COMPANY_____

ADDRESS_____

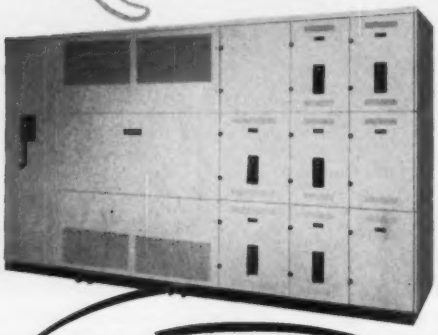
CITY_____ STATE_____

SM56-6

"It ain't tin!"

. . . says the man who installs a

NELSON UNIT SUBSTATION



Nelson unit substation with incoming load break interrupter switch, 500 kva air-cooled transformer and low voltage main and branch breakers.

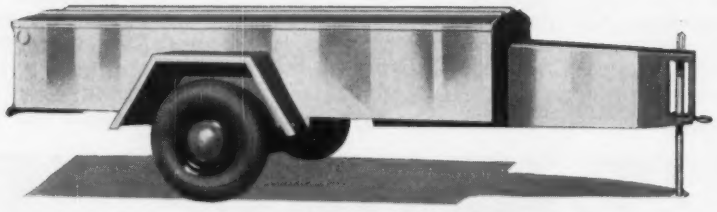
To protect the fine components that form the operating heart of a Nelson unit substation, we build heavy-duty steel enclosures that are strong and solid throughout. Extra-heavy steel channels provide a firm base for the assembly.

Nelson unit substations are manufactured with air, oil or non-inflammable, liquid-filled transformers; and, built integrally with these transformers, are Nelson switchgear, motor control centers and all-in-one substations.

Maximum voltages from 13,800 volts primary to 600 volts secondary.

• Write for literature . . . . .

NELSON Electric MANUFACTURING CO.
TULSA, OKLAHOMA



a new low cost TRAILER FOR HOTSTICK EQUIPMENT

UNITIZED BODY DESIGN permits fabrication from lighter gauge steel keeping cost and weight to minimum.

TORSION SPRINGS and correct center of balance guarantees excellent roadability.

HITCH changeable to any one of four positions.

TOP is designed with minimum weight, permitting one man to lift it easily.

PADDED RACKS (3 center—4 each side) employ padded tension spring hold downs that can be quickly removed.

STORAGE CAPACITY is ample for complete hot line tool set and accessories.

▶ Your inquiries covering this and other quality BODENDIECK products are invited. Prices and specifications promptly sent on request.

check TOOLS

BODENDIECK TOOL CO.

TAYLORVILLE, ILLINOIS

SALES ASSIGNMENTS

COMPANY STAFFS

Electric Service Manufacturing Co's new sales promotion manager is Charles D. Karlsruher, formerly with George Black Co . . . Everett G. Parmele has been appointed representative for the company in Arkansas, New Mexico, Oklahoma, and Texas.

Graybar Electric Co, Inc, has named L. J. O'Connell manager of transportation sales at general headquarters, New York City. E. R. Yonkers becomes Graybar district manager at New York.

Miller Co's Illuminating Division has announced the appointment of Jerry J. Poniske as sales representative to the firm of Custer & Co, sales agency for the company in the St. Louis area.

Pittsburgh Reflector Co has appointed Robert J. Kuzel, Jr. to handle engineering, sales, and service for the entire line of Pittsburgh Permaflector fluorescent and incandescent lighting equipment in northern Illinois.

Radio Corporation of America's communications products department of RCA Commercial Electronic Products has named John L. Salladin field sales representative for RCA microwave radio equipment in the eastern region. He succeeds E. J. Hart, recently advanced to manager, microwave equipment sales.

S&C Electric Co has announced the addition of A. T. Hawkins as sales engineer. He will headquarter in St. Louis and serve company customers in Iowa, southern Illinois, and eastern Missouri.

Sylvania Electric Products, Inc, has named Alfred T. Shore as a sales representative for equipment sales in the eastern region for the Electronic Products Sales Department. His headquarters will be at the Teterboro (N. J.) sales offices of the company.

REPRESENTATIVES

General Electric Co has named four new weathertron distributors in Texas. Appointed as heat pump retailer-wholesalers are Wheeler-Rhodes Air Conditioning Co, McAllen, Texas; Austin Air Conditioning Co, Inc, Austin; and Texas General Air Conditioning Co, Corpus Christi. Kerr Lumber Co, San Antonio, has been named wholesaler for that area.

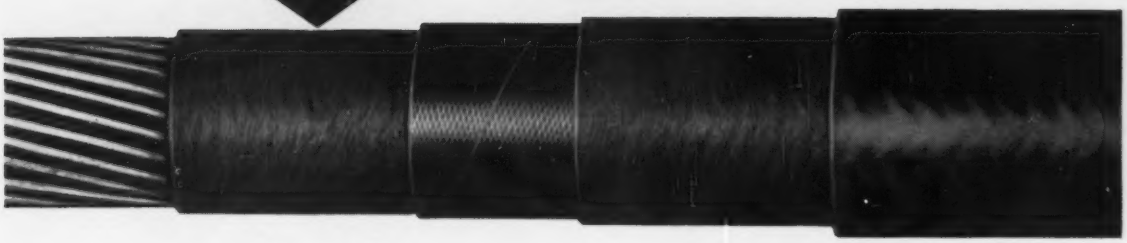
P. R. Mallory Co's Metals Division has announced the appointment of the Wendt-Sonis Co, Hannibal, Mo., as exclusive sales outlet in the cutting tool field for No-Chat.

Porcelain Products, Inc, has announced it is now being represented in Iowa by the Donald Corp, Des Moines.

J. F. Pritchard & Co has designated the Ernest L. Graves Co, Tulsa, as sales representative in Oklahoma.

Look beneath the braid

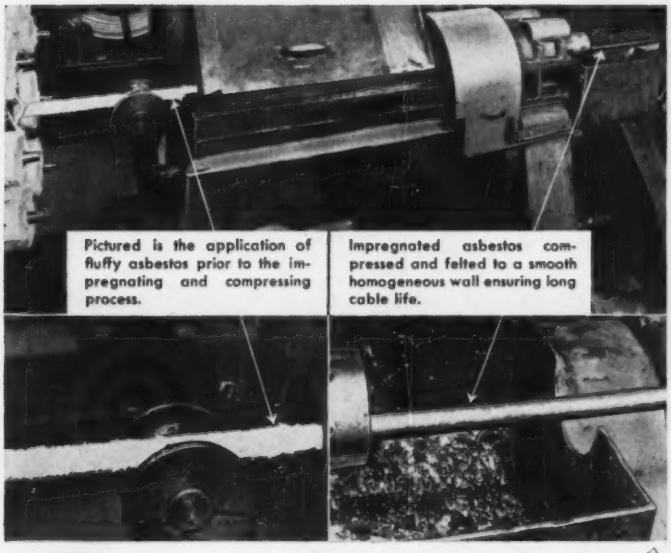
...that's where quality begins



these service proved felted asbestos walls insure uninterrupted operation with

ROCKBESTOS A. V. C.®

(N.E.C. Type AVA)



Pictured is the application of fluffy asbestos prior to the impregnating and compressing process.

Impregnated asbestos compressed and felted to a smooth homogeneous wall ensuring long cable life.

There's a reason why Rockbestos A.V.C. (N.E.C. Type AVA) gives such outstanding service in industry. It is the uniform, dense, felted asbestos walls which have been thoroughly impregnated with selected compounds and firmly compressed without laps, seams or joints to make them resistant to heat and moisture. Felted asbestos walls seal the varnished cambric tapes away from heat and moisture . . . keep dielectric strength high . . . add strength and protection against damage from flexing.

Because of felted asbestos wall construction you benefit with trouble-free, uninterrupted service under conditions such as high ambient temperature, overloads, exposure to heat, oil, grease, corrosive fumes and exposure to moisture.

Complete construction and test specifications of Rockbestos A.V.C. (N.E.C. Type AVA) are in the new booklet: "Specification RSS-88."

Write for your free copy.

ROCKBESTOS PRODUCTS CORP.

NEW HAVEN 4, CONN.

NEW YORK • CLEVELAND • DETROIT • CHICAGO
PITTSBURGH • ST. LOUIS • LOS ANGELES • NEW ORLEANS
OAKLAND, CALIFORNIA

STOCKED COAST TO COAST
Standard Rockbestos A.V.C. construction (N.E.C. types AVA, AVB, etc.) are available for immediate shipment. Call or write nearest branch office.

GENERAL ELECTRIC ANNOUNCES

22-Channel Oscillograph; Provides

PM-21 Oscillograph's Roll-out Chassis Saves Time, Reduces Cost of Operation and Maintenance

With the PM-21's exclusive roll-out chassis, you just ROLL OUT THE OSCILLOGRAPH—the sides, rear, and all parts are readily accessible for quick, easy operation and maintenance. Roll it in and the oscillograph is conveniently out of the way and protected by a metal door. A trouble light and operation counter show on the door.

ALL CONNECTIONS ARE IN THE REAR of the oscillograph, and quick-disconnect-type connectors permit easy removal for general-purpose use.

FOR MORE INFORMATION, contact your nearest G-E Apparatus Sales Office or write for bulletin GED-3049 to Section 585-32, General Electric, Schenectady 5, N. Y.

GENERAL ELECTRIC

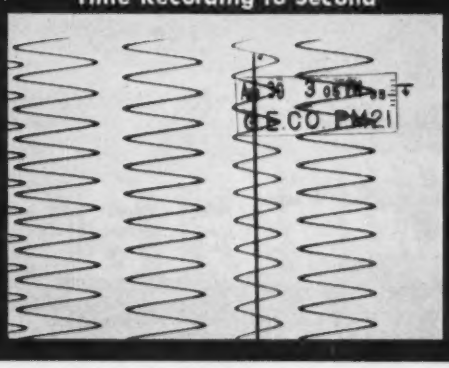
New Versatility, Economy Features

Fully-automatic Oscillograph Answers Utilities' Need for Greater Galvanometer Versatility, Easier Maintenance and Service, and Quick Change to General-purpose Use

22 Channels

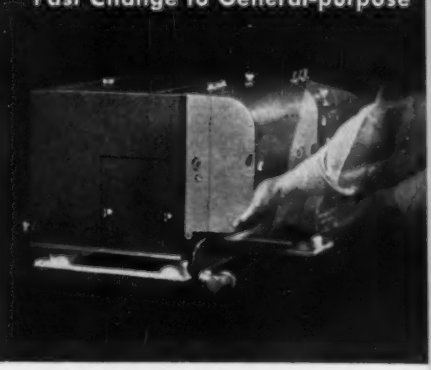
GREATER GALVANOMETER VERSATILITY is provided—holds from 1 to 22 bifilar galvanometers, or 11 to 18 bifilar plus 14 to 60 pencil-type galvanometers.

Time Recording to Second



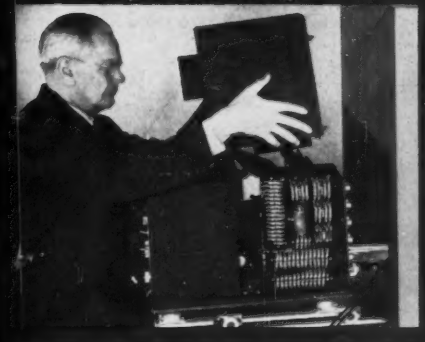
NO DECODING IS NECESSARY, and you get time recording to the second at the end of each record. A station identification nameplate can also be added for photographing on the record.

Fast Change to General-purpose



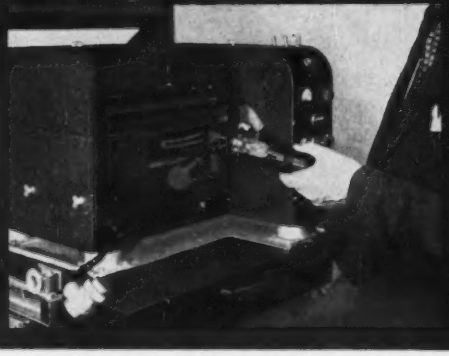
FOR STAGED TESTS, replace automatic record-paper holder with general-purpose holder to get continuously variable paper speeds of 4–500 feet/min.

Easy-access Design



QUICK ACCESS TO ALL VITAL PARTS is provided by hinged doors in the case. For complete access, loosen 3 fasteners and entire cover can be removed.

Easy Access to Lamps



LAMPS ARE EASILY ACCESSIBLE for replacement. Remove record holder, and lamp holders swing out for simple removal. Anyone can replace lamps since no optical adjustments are needed.

Separate Paper Holders

2 PAPER HOLDERS (lower for exposed; upper for unexposed) allow removal of lower holder to darkroom. A spare replaces it for continuous operation.

Progress Is Our Most Important Product

GENERAL ELECTRIC

MEETINGS CALENDAR

MAY

ARKANSAS POWER & LIGHT CO—Dealer Coordination Committee, Southeastern Area Workshop, Arlington Hotel, Hot Springs, Ark., May 28-29.

CIGRE—16th Annual International Conference, Paris, France, May 30-June 9.

JUNE

ELECTRIC COMPANIES PUBLIC INFORMATION PROGRAM—Steering Committee Meeting, Traymore Hotel, Atlantic City, New Jersey, June 3.

EDISON ELECTRIC INSTITUTE—24th Annual Convention, Traymore Hotel, Atlantic City, June 4-6.

NATIONAL FIRE PROTECTION ASSOCIATION—60th Annual Meeting, Statler Hotel, Boston, Mass., June 4-8.

NATIONAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS—48th Annual Convention, Ambassador & Chelsea and Ritz Hotels, Atlantic City, N. J., June 11-14.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Semi-Annual Meeting, Statler Hotel, Cleveland, Ohio, June 17-21.

AMERICAN SOCIETY OF TESTING MATERIALS—59th Annual Meeting & 12th Apparatus Exhibit, Chalfonte-Haddon Hall, Atlantic City, N. J., June 17-22.

FIFTH WORLD POWER CONFERENCE—Vienna, Austria, June 17-23.

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS—Semi-Annual Meeting, Washington, D. C., June 18-20.

CANADIAN ELECTRICAL ASSOCIATION—Annual Convention, Manoir Richelieu, Murray Bay, Quebec, June 18-20.

ELECTRICAL EQUIPMENT REPRESENTATIVES ASSOCIATION—Summer Meeting, La Playa Hotel, Carmel, Calif., June 20-23.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION—Accounting & Business Practice Section, Multnomah Hotel, Portland, Oregon, June 21-23.

PUBLIC UTILITIES ASSOCIATION OF THE VIRGINIAS—Accident Prevention Committee Conference, Hotel Roanoke, Roanoke, Va., June 22.

WISCONSIN UTILITIES ASSOCIATION—Accounting Section Convention, Schwartz Hotel, Elkhart Lake, Wis., June 24-26.

MICHIGAN ELECTRIC ASSOCIATION—Annual Convention, Grand Hotel, Mackinac Island, Mich., June 24-27.

ATOMIC INDUSTRIAL FORUM, INC—Conference sponsored jointly with the Denver Research Institute, Denver, Colorado, June 25-26.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Summer and Pacific General Meetings, Fairmount Hotel, San Francisco, California, June 25-29.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION—Annual Meeting, Iowa State College, Ames, Iowa, June 25-29.

AMERICAN CHIEF ENGINEERS' ASSOCIATION—Northwest Power Show, Minneapolis Auditorium, Minneapolis, Minnesota, June 28-July 1.

JULY

SOUTHEASTERN ELECTRIC EXCHANGE—Personnel Administration Section, General Oglethorpe Hotel, Savannah, Georgia, July 12-13.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION—Council Meeting, Geneva, Switzerland, July 16-21.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS—Annual Convention, Sheraton Palace Hotel, San Francisco, Calif., July 24-27.

COLUMBIA UNIVERSITY INDUSTRIAL & MANAGEMENT ENGINEERING DEPARTMENT—Fifth Annual Utility Management Workshop, Arden House, Harriman, New York, July 29-Aug. 10.

AUGUST

WESTERN ELECTRONIC SHOW AND CONVENTION—Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, California, Aug. 21-24.

SEPTEMBER

NORTHWEST PUBLIC POWER ASSOCIATION, INC—Accounting Section, Cascadian Hotel, Wenatchee, Wash., Sept. 11-14.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—3rd Annual Electrical Conference of the Petroleum Industry, Kansas City, Mo., Sept. 12-14.

EDISON ELECTRIC INSTITUTE—Organization Meeting, sponsored jointly with AGA, Edgewater Beach Hotel, Chicago, Ill., Sept. 13-14; Industrial Relations Round Table Conference, Drake Hotel, Chicago, Ill., Sept. 17-19; Meter & Service Committee, Purdue University, Lafayette, Ind., Sept. 24-26.

PUBLIC UTILITIES ASSOCIATION OF THE VIRGINIAS—38th Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., Sept. 14-15.

ILLUMINATING ENGINEERING SOCIETY—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

INSTRUMENT SOCIETY OF AMERICA—11th Annual Instrument-Automation Conference and Exhibit, New York Coliseum, Sept. 17-21.

ATOMIC INDUSTRIAL FORUM, INC—3rd Annual Forum Conference and 2nd Annual Trade Fair, Morrison Hotel and Navy Pier, Chicago, Ill., Sept. 24-28.

PENNSYLVANIA ELECTRIC ASSOCIATION—Annual Meeting, Hotel Wm. Penn, Pittsburgh, Pa., Sept. 25-26.

ELECTRIC COMPANIES PUBLIC INFORMATION PROGRAM—Steering Committee, Blackstone Hotel, Chicago, Ill., Sept. 26; Workshop Conference, Blackstone Hotel, Chicago, Ill., Sept. 26-28.

OCTOBER

***EDISON ELECTRIC INSTITUTE**—Prime Movers Committee, Hotel Radisson, Minneapolis, Minn., Oct. 1-3; Electrical Equipment Committee, Hotel Statler, Cleveland, Ohio, Oct. 15-16; Transmission and Distribution Committee, Hotel Statler, Buffalo, N. Y., Oct. 18-19.

***AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS**—Fall General Meeting, Morrison Hotel, Chicago, Ill., Oct. 1-5.

***INDIANA ELECTRICAL ASSOCIATION**—Annual Convention, French Lick Springs Hotel, French Lick, Ind., Oct. 3-5.

***ROCKY MOUNTAIN ELECTRICAL LEAGUE**—Annual Fall Convention, Broadmoor Hotel, Colorado Springs, Colo., Oct. 7-10.

***INTERSTATE POWER CLUB**—Hotel Martinique, New York, Oct. 8.

***ILLINOIS INSTITUTE OF TECHNOLOGY**—Conference on Computer Applications, Chicago, Ill., Oct. 9-10.

***AMERICAN STANDARDS ASSOCIATION**—38th Annual Meeting and 7th National Conference on Standards, Hotel Roosevelt, New York, Oct. 22-24.

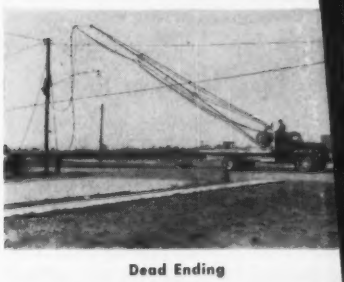
---

* Additions this week

*Automatic Lineman**

STRINGS WIRE FOR $6.00 PER MILE

ACTUALLY SAVES 80% OF PRESENT COSTS



Dead Ending

Passing Wire Through Trees

Mounts upon any mobile-type of equipment—Truck, Tractor, Halftrack, Dolly or Motor Car. Easy to mount—only 4 bolts required.

22 Ft. Boom can be extended to 67 ft.

Increasing Tension

SHOULD PAY FOR ITSELF ON YOUR FIRST JOB!

Write for literature giving full details and price.

Automatic Lineman Corp.

1572 Cordova Avenue Cleveland 7, Ohio

Patents Applied For*

Just 4 Simple Steps to Install

ALLIS-CHALMERS Core and Coil Replacement Assemblies

1. Attach brackets on top and bottom of side frame, using bolts in frame. If old anchoring studs or lugs are not already suitably located in tank wall, weld new ones in position.

2. Position core and coil assembly over tank. Adjust expandable bottom brackets to meet side of tank wall to assure accurate fit.

3. Lower assembly into tank and adjust top brackets to meet lugs in side wall. Anchor in place.

4. After cutting leads to required length, braze the terminals to the leads (all leads and terminals are identified).

You can use Allis-Chalmers replacement units in any type transformer tank. They are packaged for convenience, immersed in oil in specially designed containers, which protect against moisture or damage during transportation. You get complete instructions with each unit.

Assemblies available in ratings 25 kva and smaller, 15 kv and below, and conform strictly to NEMA standards. Use them in either conventional or protected types. Provision for mounting low voltage breaker, and a winding to operate signal light are standard.

★ ★ ★

GET ORIGINAL FACTORY QUALITY. Call your nearby A-C office for information. Or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 61B6345A.

A-4884

ALLIS-CHALMERS

at your fingertips!

. . . a full year's editorial coverage of the electric power industry!

You'll appreciate these attractive, businesslike files to make the year's copies of Electrical World a functional, permanent part of your business or home library. With the indexes bound into the issues twice annually they'll provide instant access to the nearly 8,000 editorial articles published each year. Just three Jesse Jones files, especially designed for Electrical World, protect a year's issues against soil, loss, wear. Copies are instantly removed for use—no wires to fuss with.

Each file is sturdily made (supports 150 lbs.) with red and black Kivar cover (closely resembles leather), lettered in 16k gold. Shipment can be made promptly at the special price of all three files for $7.00, postpaid. And don't forget—SATISFACTION UNCONDITIONALLY GUARANTEED OR YOUR MONEY BACK.

Jesse Jones Box Corp., Dept. EW
PO Box 5120
Philadelphia 41, Penna.

Please send postpaid....Electrical World files, for which I enclose $..... Or please bill me ( ).

Name .....

Address .....

City .....State .....

Lack of Engineers . . .

called stumbling block in development of nuclear energy. 'Old timers' may be able to supply assistance

The shortage of engineers is the major stumbling block in the development of nuclear energy. This was voiced by many speakers at the Forum on Prospects for Atomic Energy in the South, held in Atlanta, Ga., on April 17-18, at which regulation also was emphasized.

Frank J. Soday, Chemstrand Corp, said that the greatest problem confronting industry is providing sufficient trained personnel for developing, constructing, and operating nuclear facilities. To meet minimum requirements in the South by 1965 excluding nuclear, he said, the Southern schools must graduate 36,000 scientists and engineers each year. This averages 2,000 per Southern state annually—three times the number to be graduated this year. And added to this shortage is the South's share of about 12,000 technical personnel for atomic work by 1965.

Start Them in Junior High

To correct this deficiency, Soday said, we should start to interest more students in junior high schools in mathematics and science. Some colleges are giving special courses for students not having prerequisites. But, he pointed out, at least one college has discontinued this program.

"Old timers" are one source of personnel to meet future demands, said W. A. Hamilton, Nuclear Development Corp of America. Retired engineers are at the peak of their ability when they retire and are not so inflexible that they cannot contribute in the nuclear field.

For old timers that don't want a fulltime job, Hamilton suggested part-time teaching positions to help meet that shortage.

"So far, our educational system has shown itself incapable of meeting the challenge which has risen to confront it," said Gen L. R. Groves, Remington Rand division of Sperry Rand Corp. Among the major shortcomings are the absurd lack of mathematics or scientific study in both high schools and colleges.

3 WAYS TO CUT POWER COSTS WITH NORDBERG ENGINES

These three typical installations show some of the ways that utilities are now utilizing Nordberg engines to increase the operating flexibility of their existing facilities and to add valuable standby protection on a financially sound, profitable basis.

Built in sizes from 10 to over 12,000 horsepower, including Diesel, Duafuel® and Spark-Ignition Gas types, Nordberg engines are easily installed, go on the line quickly and provide low cost power generation under all load conditions.

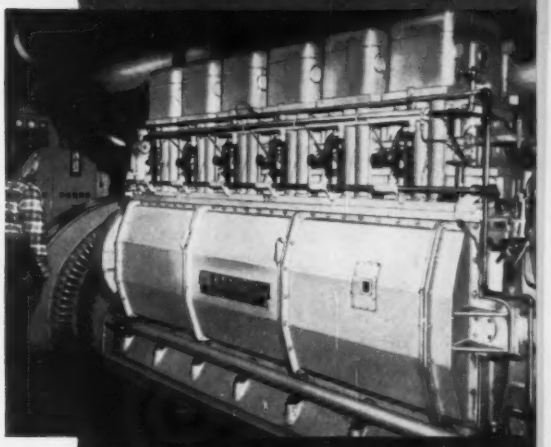
Let experienced Nordberg engineers help solve your specific power problem.
Write for further information.

NORDBERG MFG. CO., Milwaukee, Wisconsin

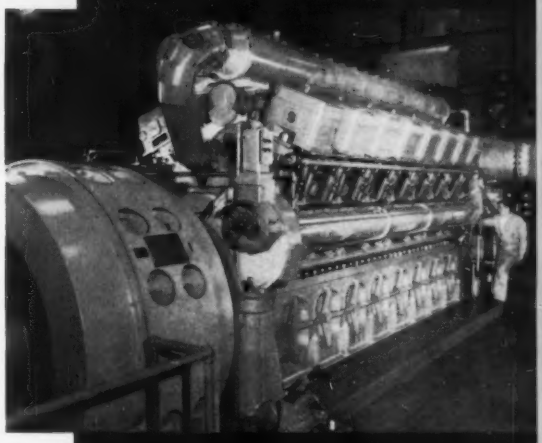
BUILDERS OF AMERICA'S LARGEST LINE OF HEAVY DUTY ENGINES . . . 10 to over 12,000 HORSEPOWER

© 1956, Nordberg Mfg. Co.

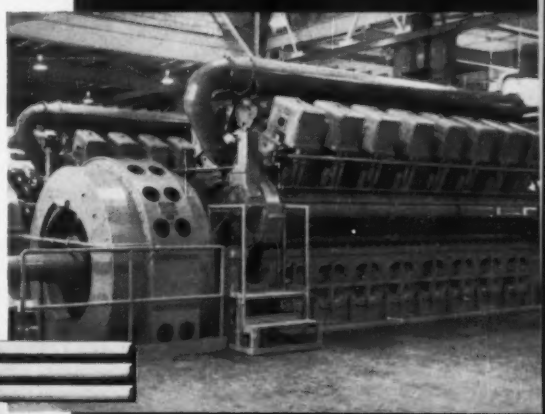
P-556



1 ***For standby service*** . . . this 1200 hp, 840 kw Nordberg *Supairthermal®* Diesel Generator is serving a Midwestern Utility Company.



2 ***For peak load service*** . . . this is one of three Nordberg *Supairthermal* Diesel generator units, ranging from 1150 kw to 2285 kw, now serving a Southern Utility Company.



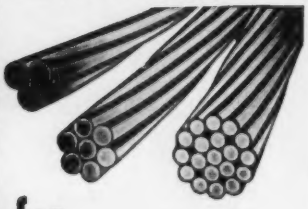
3 ***For boosting voltage*** . . . these are two 3500 hp, 2500 kw Nordberg Diesel Generator units serving an Eastern Utility Company.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

ACCO Quality

PAGE Stainless Steel Strand



for Severe Service Conditions

PAGE Stainless Steel Strand is equally versatile for ground, guy and catenary applications. Its higher tensile strength, corrosion-and-abrasion resistance, elastic limit and strength-to-weight ratio make it your first choice! Its lower cost per year of use means long-range economy.

Write us at Monessen, Pa., for complete information

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

for Better Value

NW Water Storage

. . . considered at NPPA meet; also diversion projects for upper Columbia River system

Proposed new sites for water storage dams, diversion projects in the upper Columbia River system, and outspoken opposition against proposed private development of the Snake River held the focus at the 16th annual Northwest Public Power Association convention in Spokane, Wash.

Before about 200 delegates, Brig Gen Louis H. Foote, North Pacific Division engineer, said much of the water storage envisioned in the Army 308 report "appears unattainable," because of changes in dams built or proposed for the Columbia River system.

Storage Reduction Predicted

General Foote said the engineers expect "the probable loss of Glacier View and Libby" and resulting reduction of storage at Grand Coulee Dam. Modifications in the program mean that "only about 50% of the storage needed appears probable of development," he pointed out. Present and proposed projects provide only 10.4-million acre ft.

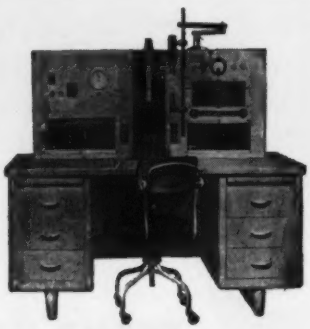
Canada also is studying storage sites with a possible total of 13- to 20-million acre ft, General Foote added. But he doubted that Arrow Lakes Dam would benefit U. S. projects—"it needs upstream augmentation for effectiveness to U. S. dams"—but thought Mica Creek Dam could be effective.

Harold R. Nelson, Boise regional director, Bureau of Reclamation, said irrigation projects that could be developed at nominal cost generally within the ability of the water users to pay entirely are becoming rare. "The bureau is not proposing any Northwest irrigation project with a financial requirement that would increase the power rate of a participating project," he stated.

Regarding additional federal power for the Northwest, Nelson said a third power plant at Grand Coulee Dam has been found feasible.

Dr William A. Pearl, Bonneville Power Administration head, advised that interruptible power will become more important as new federal power plants are completed in the Columbia basin. He estimated that "long-term industrial power contracts now pro-

(*Continued on page* 248)



Save time testing watthour meters with the

KNOPP

Meter-Testing Equipment, Type TE-7

Power companies the nation over, save time, save money, and build customer goodwill when testing watthour meters with the Knopp Meter-Testing Equipment.

Has Knopp Unload† System with Unilink† series-test feature enabling testing of both elements of a 3-wire, single-phase meter simultaneously without opening the potential link.* Basic constant of rotating standard adjustable to match basic constant of meter-under-test.* Its new, more-convenient switching arrangement for connecting meter elements permits 2-element and 3-element polyphase meter testing without changing connections. Includes photoelectric counter and other time-saving features for accurate testing.

Tests all types of watthour meters. Provides voltage ranges of 120, 240, and 480; current ranges of .25, .5, 1, 1.5, 2.5, 5, 10, 15, 25, and 50. Overall equipment accuracy within .05%.

* *Patented* † *Trademark*

KNOPP Phase Shifter

You can have any leading or lagging phase angle by manually controlling the position of the rotor. One scale shows degrees for electrical angle of displacement; another, corresponding power-factor values. Gives true power-factor readings under all conditions. Highly accurate. Input: 120/240 v. 3-phase, delta. Output: 120 or 240 v. 3-phase, delta. Other ratings available.

Also: Knopp Precision Transformers; Knopp Unload Equipment for testing instruments and instrument transformers.

For complete technical descriptions please write us today

KNOPP INC.

Founded in 1928 by Otto A. Knopp under the name of Electrical Facilities Inc.

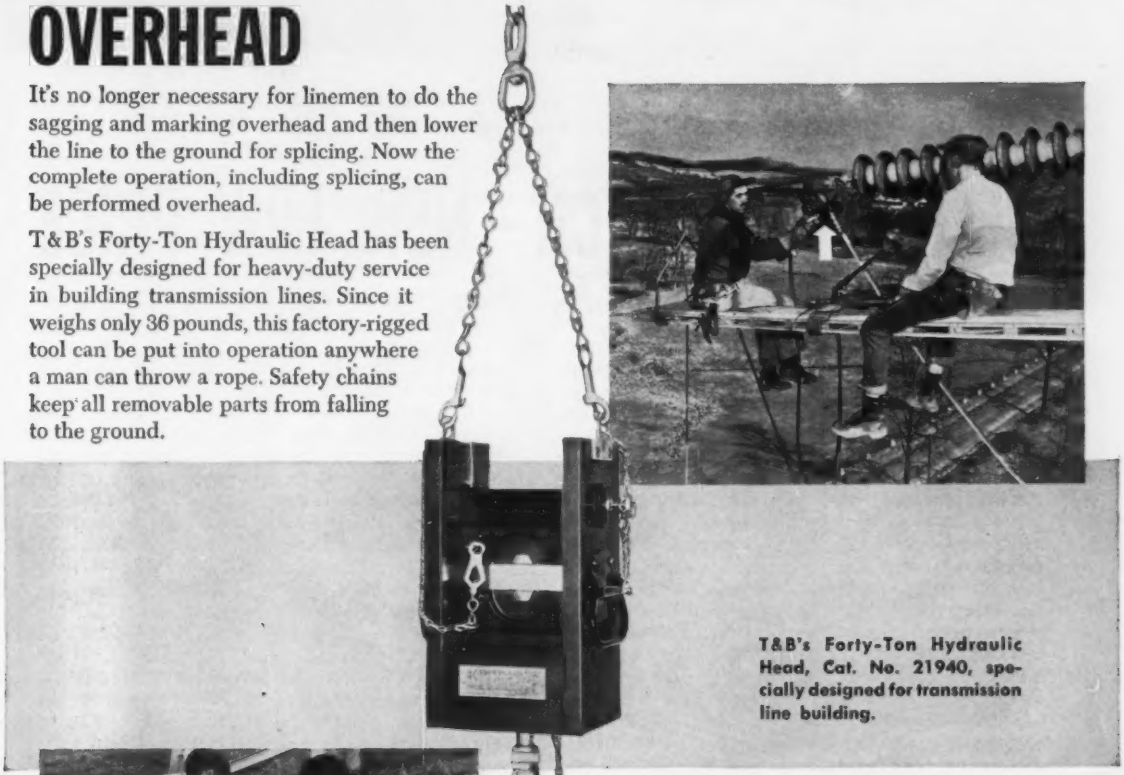
4236 Holden St., Oakland 8, Calif.

Now *ONE* portable tool makes transmission line splices

OVERHEAD

It's no longer necessary for linemen to do the sagging and marking overhead and then lower the line to the ground for splicing. Now the complete operation, including splicing, can be performed overhead.

T&B's Forty-Ton Hydraulic Head has been specially designed for heavy-duty service in building transmission lines. Since it weighs only 36 pounds, this factory-rigged tool can be put into operation anywhere a man can throw a rope. Safety chains keep all removable parts from falling to the ground.



T&B's Forty-Ton Hydraulic Head, Cat. No. 21940, specially designed for transmission line building.

or ON THE GROUND

Demountable legs hold T&B's Forty-Ton Hydraulic Head at convenient working height when installations are being made on the ground. During operation, hardened steel dies compress fitting and cable hexagonally into one homogeneous mass . . . all in a few seconds. The same die set installs tension splicers, dead ends, loop splicers and taps, tees and terminals.

Modern hydraulic design has virtually eliminated the need for maintenance. However, field maintenance is simple and practical. The 21940 Installing Head can be completely disassembled and reassembled in less than one-half hour with these common tools: screw driver, Allen wrench, and mallet.

T&B Bulletin 70 gives a detailed description of the Forty-Ton Hydraulic Head as well as complete lines of T&B connectors, tools, and accessories for transmission line building. Send for FREE copy.

LOOK FOR THIS SIGN — AUTHORIZED DISTRIBUTOR T&B ENGINEERED

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T-418

THE THOMAS & BETTS CO.

INCORPORATED

14 Butler Street • Elizabeth 1, New Jersey

Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

THE GENERAL ELECTRIC TSA-40

NEW TIME SWITCH—NEW LOW PRICE

Replacing Type T-27

TSA-40, an entirely new heavy-duty general purpose time switch, has been designed by General Electric to meet your demands for more reliable on-off operation at a lower price.

MANY NEW FEATURES make the TSA-40 a superior time switch for all heavy-duty, on-off applications. Exclusive contact shearing action gives you reliability and long life; new case, latch and cover gasket give complete weather-proofing; smaller size and more wiring space cut installation and maintenance costs; and extended operating temperature limits provide dependable service under a wide range of ambient conditions.

VERSATILE IN APPLICATION, the TSA-40 offers precise and reliable control of all types of street, sign, store window and floor lighting; capacitor switching; heating, air conditioning, and refrigeration; irrigation and pump control; and many other industrial and central station uses. The TSA-40 is fully suitable for both indoor and outdoor applications.

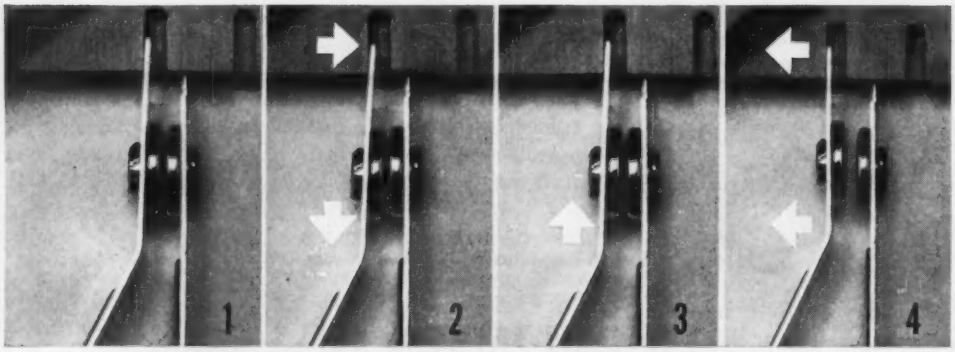
YOU GET EXTRA VERSATILITY when you order a TSA-40 with either or both of these optional features. The *omitting device* permits the TSA-40 to omit its operation on any day or days of the week. It can be added to a standard switch that is already installed. The *astronomic dial* is a special time dial which follows the changing schedule of sunset and sunrise in a particular locality. You save on cost of servicing because the need for regulating the time switch as the days grow longer or shorter is eliminated.

FOR PRICES AND FURTHER INFORMATION, call your nearest General Electric Apparatus Sales Office or write for Bulletin GEA-6468 to Section 584–4, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

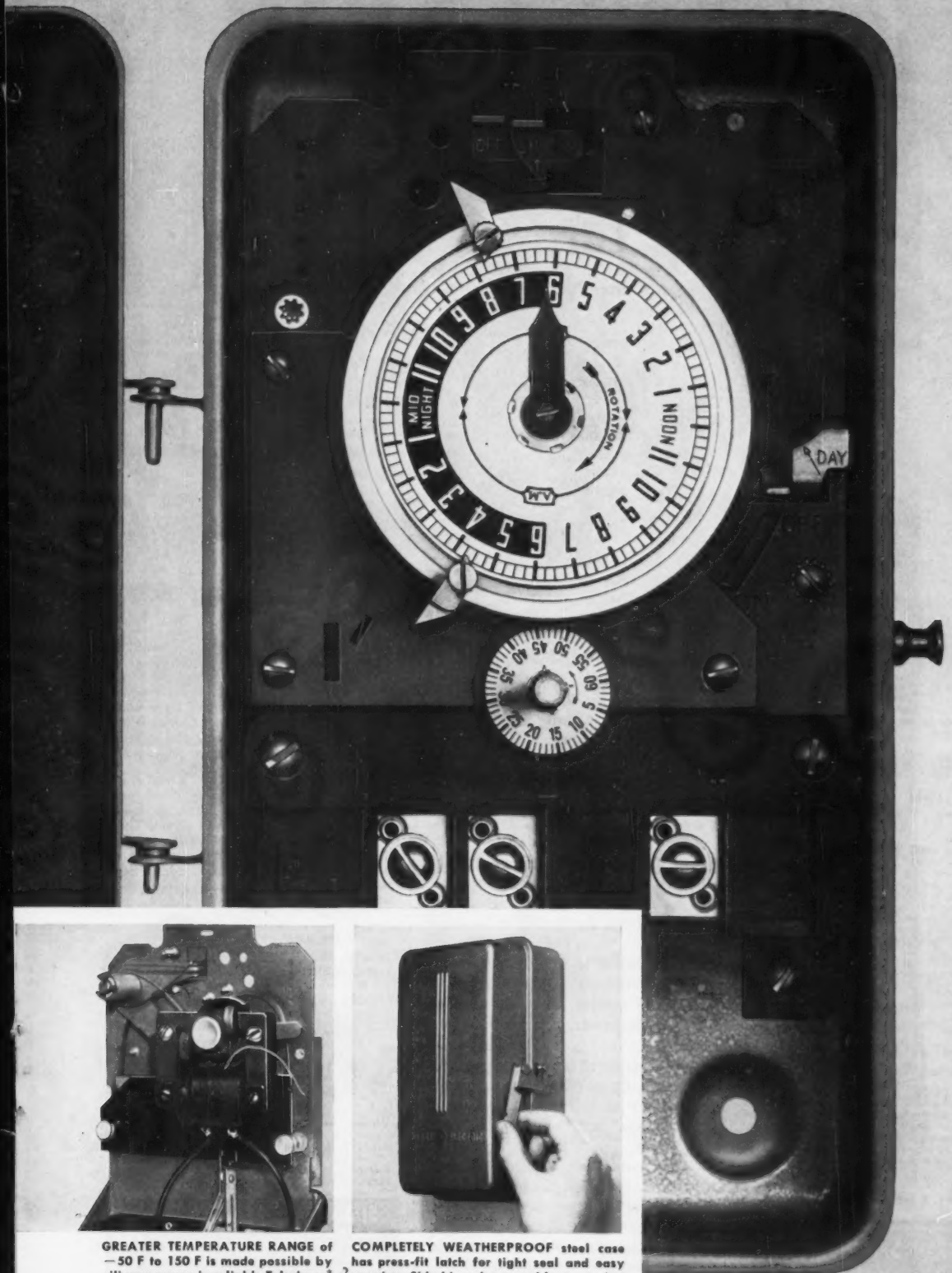
EXCLUSIVE CONTACT SHEARING ACTION GIVES GREATER RELIABILITY



WELDS ARE BROKEN, CONTACTS KEPT CLEAN BY THIS SHEARING ACTION:
(1) Contacts, shown here in closed position, are actuated by slotted bar at top of these actual photographs. At start of opening action (2), bar moves to right forcing left contact to move down with shearing action. As bar completes motion to right (3) contacts are released and spring blades cause second shearing action just before contacts snap open (4). Bar returns to first position ready for next operation.

NO WIRING BURNOUTS or "hot spots" because one-piece contact and terminal eliminate all internal wiring to contacts. Unit terminal block makes replacement easy.

ACTUAL SIZE



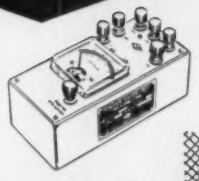
GREATER TEMPERATURE RANGE of —50 F to 150 F is made possible by silicone grease in reliable Telechron* motor. Direct drive of switching mechanism assures positive action.

COMPLETELY WEATHERPROOF steel case has press-fit latch for tight seal and easy opening. Side-hinged removable cover simplifies installation and maintenance.

*Reg. trademark General Electric Co.

Investigate
these
METER TESTING ACCESSORIES
Now in use by Leading Utility Companies

FIELD TEST SET



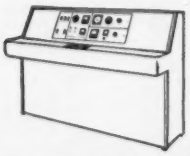
This instrument is a simple, inexpensive, portable means whereby the customer's current transformer installation may be quickly checked for basic sources of trouble.

POTENTIAL SWITCH for METER TESTING

This is a special form of the well-known snap action Micro Switch; needs only 6 ounces of pressure to operate it; long lived — modified to suit the requirements of manual control of rotating standard potential.

INSULATION TESTER

Developed in response to the need for an insulation testing device that would have: maximum safety, instantaneous indication, direct reading in megohms without calculations, ability to discriminate between a complete insulation breakdown and leakage through insulation, portability and compactness.



METER TESTING POWER SUPPLY

The purpose of this apparatus is to furnish a stable and controlled source of single phase potential and single phase current for general testing purposes, together with means for adjusting the phase angle so that power may be supplied at any desired power factor, leading or lagging.

Write for Complete Information

EASTERN SPECIALTY CO.
PHILADELPHIA 40, PA.

NW Water Storage

(*Continued from page* 244)

posed by BPA have considerable significance for industrial development, partnership projects, and steam plants. Formalizing arrangements for delivering about 680,000 kw of high-quality interruptible power to present industrial customers will substantially protect an industry investment of about $100 million," he observed.

Pearl said an additional bloc of 100,000 kw of interruptible power will be reserved for new industries. He forecast that supplementing this power with steam generation could allow an industry to establish itself pending delivery of firm power from new projects.

Hydro's Lure Seen Lessened

The Northwest should not be complacent about cheap power's attraction to industry, cautioned Dr William Dittmer, power manager, Kaiser Aluminum and Chemical Corp. "The increased efficiency of steam generation, especially as demonstrated in the Ohio valley, is reducing hydroelectric power's lure," and industries are likely to settle near raw materials and transportation in areas served by steam generation, Dittmer declared.

Alex Radin, general manager, American Public Power Association, charged that the bill (S. 2643), introduced by Sen Charles E. Potter (R-Mich.) and now before Congress, "is so broad in its terms that it would exempt from the Holding Company Act such new companies as the Pacific Northwest Power Co."

He forecast a court decision on the Federal Power Commission license for the Hells Canyon project issued to Idaho Power Co by the end of June. He compared the license to "a somewhat similar case, (when) the FPC denied a license to Washington Water Power Co to build a small Kettle Falls Dam, a project that would have blocked construction of Grand Coulee."

Radin declared the bill sponsored by Rep Sam Coon (R-Ore.) "provides a completely unacceptable method of construction" for the proposed John Day Dam.

The Association elected Peter C. Spowart, assistant superintendent, Seattle City Light, as its new president, succeeding Ora A. Beasley, manager, Northern Lights, Inc, Sandpoint, Idaho.

(*Continued on page* 250)

Every Movement has a SAVINGS of its own . . . . .

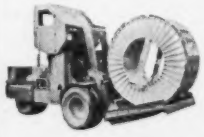
SAVE UP TO 75% of MATERIALS HANDLING COSTS WITH

HEAVY-DUTY FORK
LIFTRUK
OR
LIFT-O-KRANE

Leading Public Utilities find these heavy-duty, rugged SILENT HOIST machines dependable and efficient for the continuous, complex requirements of the transportation department, storage area, repair shop . . . in the movement of Generators and other heavy equipment, Cable, Wire, Maintenance Supplies, Poles and general equipment.

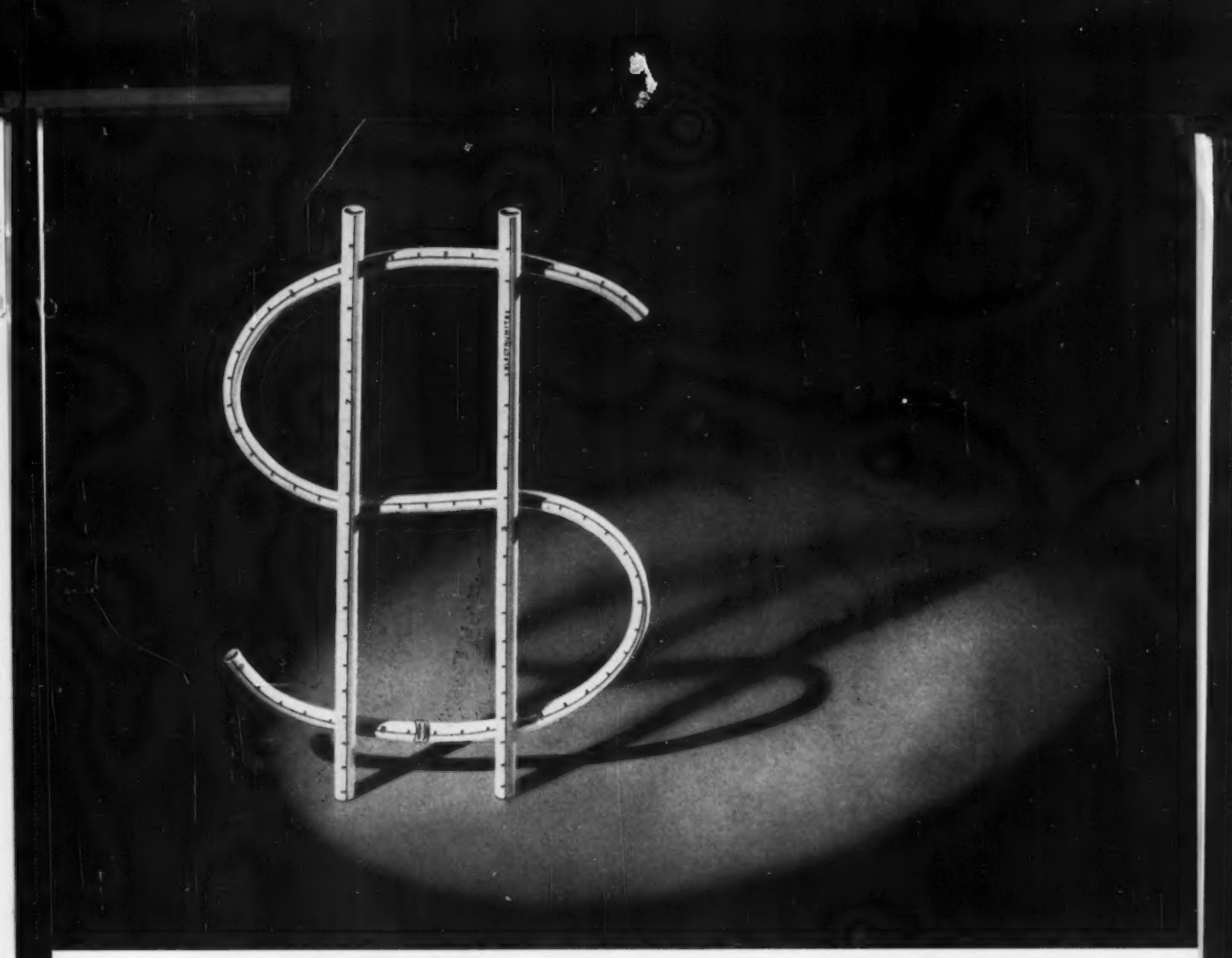
The LIFTRUK *Fork Lift Truck* and LIFT-O-KRANE *Combination Crane and Fork Lift Truck* handle capacity loads with maximum stability and safety. They have high lifting range. Make short turns in narrow spaces. Promote maximum efficiency for storage areas . . . and effect rapid inloading and outloading, with economic use of manpower.

Send for Bulletin 77 for LIFTRUK. Bulletin 75 for LIFT-O-KRANE



Makers of KRANE KAR Mobile Boom Crane, KARRI-GO Front Boom Crane, SILENT HOIST Cranes for Motor Truck Mounting, SILENT HOIST Winches and Capstans, SILENT HOIST Hydraulic Telescopic Truck Towers, etc.

SILENT HOIST & CRANE CO.
Pioneer Manufacturers of Heavy-Duty Equipment for Public Utilities and Municipalities
862 63RD STREET, BROOKLYN 20, N. Y.



EASY BENDING IS DOLLAR-SAVING

with Republic ELECTRUNITE E.M.T.

Saving dollars is a certainty on practically every Republic ELECTRUNITE® E.M.T. job because installation is so easy.

Here's an electrical conduit that will provide years of dependable protection at less cost. Utility jobs installed more than 25 years ago are still giving users trouble-free service. And the amount of footage successfully installed in concrete is in the hundreds of millions.

There's no kinking... no wrinkling—even when bends are a full 90°—because ELECTRUNITE is *uniformly ductile.* Installation is faster because ELECTRUNITE E.M.T. is lighter. And less weight means easier handling, lower costs.

You get additional savings because there are no threads to cut, no runs to turn. Every joint becomes a union. And since threading is unnecessary, the tightly adhering galvanized coating remains unbroken—assuring permanent end-to-end circuit protection from corrosion.

It will pay you to check the cost advantages of Republic ELECTRUNITE E.M.T.—the electrical conduit that offers such exclusive features as "Inch-Marked"® and "Guide-Lined." It's produced to ASA specification C-80.3, Federal Specification WW-T-806 and carries the Underwriters' Laboratories Seal of Inspection. Write for all the facts. *Send for your free copy of 84-page* ELECTRUNITE *bending instruction booklet.*

REPUBLIC STEEL

Steel and Tubes Division
213 East 131st Street • Cleveland 8, Ohio

World's Widest Range of Standard Steels and Steel Products

Pat. Pend.

*KLEIN KUT PLIERS

for both regular and heavy-duty cutting

It was Klein that produced the first and still the finest regular side-cutting plier. Klein also gave the industry the modern, streamlined version so much in demand.

And it's Klein again with a new, high leverage cutting plier for light- or heavy-gauge wire, including No. 2 weatherproof hard drawn solid copper wire, and A.C.S.R.

There's no extra hinging of any kind—no uncomfortable wide-spread handles—with this new Klein-Kut Plier. The offset hinge permits the extra-high leverage and operation is as smooth and easy as with any other Klein Plier. Forged from high-grade tool steel, individually fitted, tempered, adjusted and tested. Ask for No. 213-9 N.E. for streamlined pattern.

Regular pattern available
Same high-leverage design, but in the original Klein side-cutting pattern. Ask for No. 213-9.

Write for free Copy of Bulletin 1054

*Trade Mark

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York.

"Since 1857"

Mathias KLEIN & Sons

NW Water Storage

(*Continued from page* 248)

Resolutions adopted by NPPA oppose construction of Mountain Sheep and Pleasant Valley projects on the Snake River and authorize intervention by the association before the FPC. In reaffirming endorsement of the Nez Perce project below these two sites on the Snake, the association asked a moratorium on its construction pending studies of multipurpose benefits.

Utilities' New Radio Uses Discussed at NCUR Meet

Frequency coordinators in nearly all Federal Communications Commission regions are receiving requests for recommendations for frequency allocation, the National Committee for Utilities Radio heard at its annual meeting at Omaha, Neb.

The NCUR executive council was directed to form a group to study new uses of radio by utilities with a view to increasing their operational efficiency. The meeting was told that the council, as previously directed, petitioned FCC for a rule change. The change would permit use of Power Radio Service manned base and mobile stations on an incidental basis. This use would involve sending coded tone signals to fixed receivers for control functions.

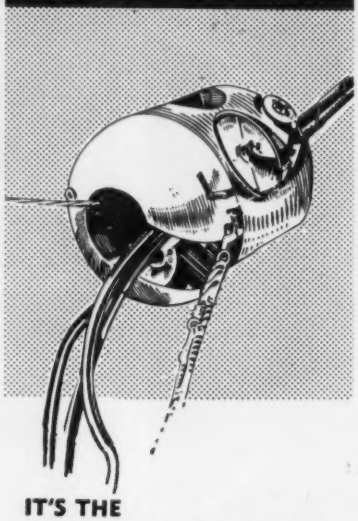
The meeting was attended by 94 representatives of regional group and trade associations. These were told that little use has been made of the higher bands for mobile systems, partly because assignment in them has been on a development basis shared with other services.

Problems of engineering, frequency coordination, and operating procedures raised by the split-channel proposal, now before FCC, will be studied further by the executive council, it was announced.

NCUR members were warned that no assurance has been afforded that new channels available through split-channel operation will be allocated to the services to which the original unsplit channel was assigned.

The committee unanimously elected the following officers for the coming year: T. G. Humphreys Jr, Alabama Gas Corp, chairman; George E. Carlson, Consumers Public Power District, vice chairman; and, John Slothower, Northern States Power Co, secretary.

THREE TO ONE



IT'S THE
NEALE MODEL "K"
Only the
Model "K" Spinner
PLACES & SPINS
THREE SINGLE CABLES
Into
ONE COMPACT UNIT

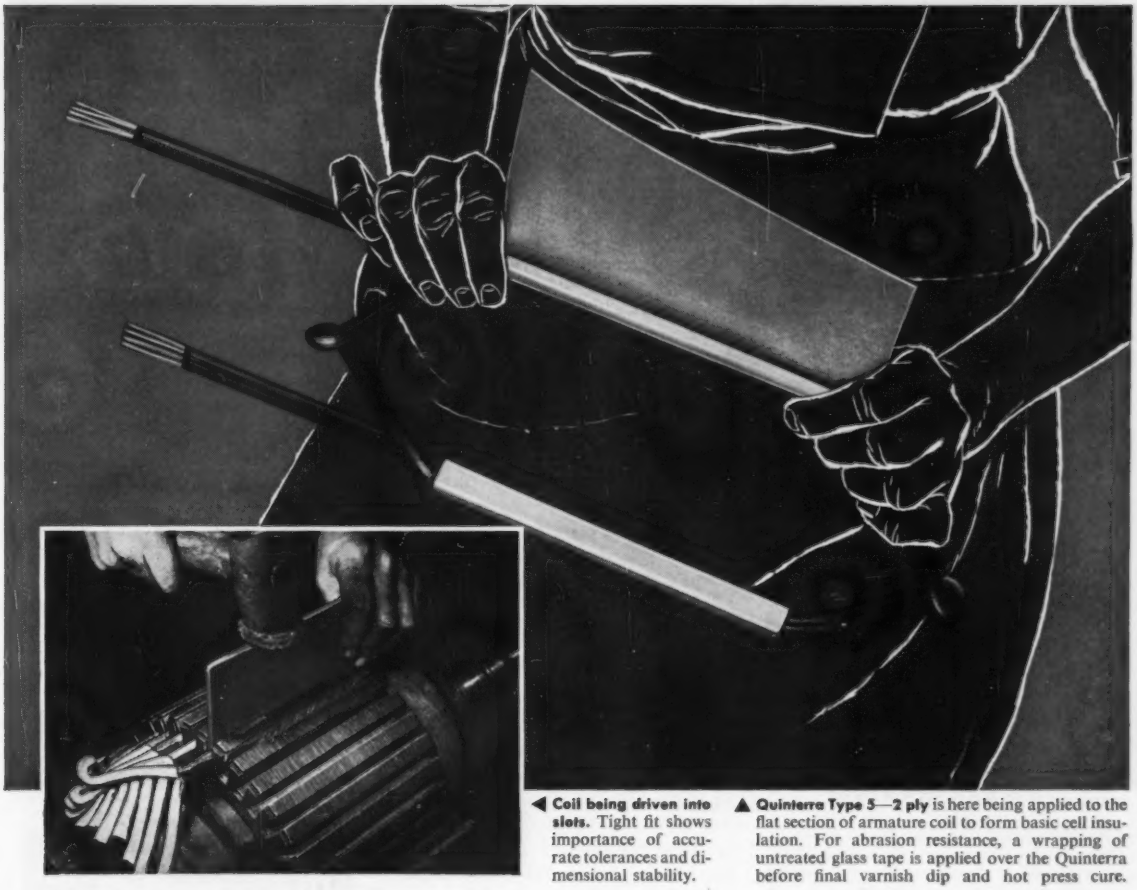
ALSO SPINS SINGLE CABLE PERFECTLY

WRITE FOR LITERATURE AND PRICES

CABLE SPINNING EQUIPMENT CO.

3100 TOPEKA AVE.
TOPEKA KANSAS
Phone 2-7234

OVERSEAS SALES:
Ericsson Telephone Sales Corp. of New York
Automatic Electric of Canada
Pirelli of Great Britain



◀ **Coil being driven into slots.** Tight fit shows importance of accurate tolerances and dimensional stability.

▲ **Quinterra Type 5—2 ply** is here being applied to the flat section of armature coil to form basic cell insulation. For abrasion resistance, a wrapping of untreated glass tape is applied over the Quinterra before final varnish dip and hot press cure.

Why West Virginia Armature Co. switched to J-M QUINTERRA® *for armature coil insulation*

West Virginia Armature Co., Bluefield, W. Va., is a leading manufacturer of motor armature coils, used by the coal mining industry—a severe and difficult field. It was only after 4 years of field testing that they decided to change to Johns-Manville Quinterra Type 5—2 ply for their traditional built-up insulation materials. They made this change because they discovered that:

1 Quinterra retains higher inherent dielectric strength under prolonged high temperature operating conditions.

2 Quinterra, manufactured to closer thickness tolerances, permits more accurately dimensioned coils, assuring easy and proper fit.

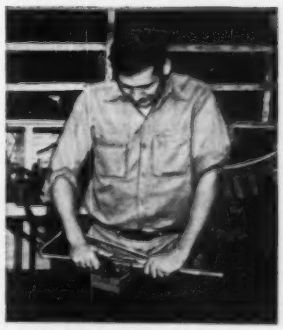
3 Quinterra is pliable, conforms readily to shape of coil and remains dimensionally stable in storage or in use.

4 Quinterra is smooth, does not crack or flake, is easy and pleasant to handle, does not harm or irritate operators' hands.

5 Quinterra is flexible, eliminates dielectric failures due to flaking or splitting.

Quinterra Type 5—2 ply is made from two sheets of highly purified asbestos treated with a polyvinyl acetate resin saturant and combined under controlled temperature and pressure. It has ample mechanical strength for easy handling. Its inherent dielectric strength exceeds 280 VPM even at temperatures over 130 C.

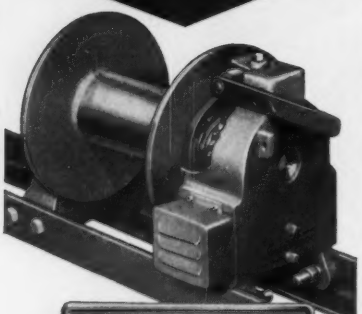
Find out how you can obtain the same benefits from Quinterra. Write for free 32 page illustrated brochure, EL-40A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit (Toronto), Ontario.



Dimensional accuracy is imperative. Here, finished coils are being tested in Go-or-No-Go gauge.

Johns-Manville ELECTRICAL INSULATIONS

ENCLOSED CLUTCH CAN'T STICK OR FREEZE *Ever!*



WINCHES

Put an advanced Gar Wood 7000 lb. winch on your utility truck and you'll put an end to clutch trouble. All moving clutch parts are *fully enclosed and running in oil* . . . can't stick, freeze or rust because weather and dirt can't get in!

You'll put an end to the hazard of sudden slippage, too. Gar Wood's self-energizing safety brake and time-tested back-draft clutch give your operator much safer control of the load.

And that's not all! Gar Wood winches feature stress-free, tempered aluminum alloy housings that are lightweight, rust-proof, built for longer life . . . built-in rope clamp for easier attaching and changing of rope, better spooling . . . self-contained ball-bearing mounted worm shaft for smoother operation . . . extra rugged base angles for an extra margin of safety.

Get all the facts about Gar Wood 7000 lb. winches, available as standard or low mount. Call your Gar Wood-St. Paul distributor or mail the coupon below.

GAR WOOD INDUSTRIES, INC.

Wayne, Michigan • Richmond, Calif.

MAIL FOR SPECIFICATIONS

Customer Service Department EW-1
Gar Wood Industries, Inc., Wayne, Michigan

Please send me specifications on Gar Wood 7000 lb. winches.

Name _____

Title _____

Company _____

Address _____

Commutator-Less Exciter

(*Continued from page* 123)

the amount of control is manually chosen by a two-gang rheostat which gives a smooth control from full buck to full boost. The manual control operates in much the same way as the standard self-excited dc exciter and is always in use.

The pre-amplifier takes the very small output of the comparator and amplifies it sufficiently to control the power amplifier. There are four control windings in the pre-amplifier. Two are used for damping the circuit, one for biasing the magnetic amplifiers to the desired output and the fourth or control winding takes the series output of the comparator and the minimum excitation circuits for automatic control.

When the transfer switch is in manual position it completely clears all the automatic control components so that work can be done on them while the excitation system is in manual control.

The excitation equipment was installed in a period when the turbine-generator was scheduled for regular inspection. All equipment was on hand when the unit was taken out of service. By carefully scheduling the work the unit was returned to service without much delay chargeable to the exciter.

The unit went back into service with the original exciter acting as the reserve exciter. This allowed use of a portion of main-field rheostat as the equivalent resistance of the field for load testing the new excitation system.

Full current heat runs were made. Many thermo-couples at strategic points provided all of the desired information on temperatures of the exciter under operating conditions.

A very close check was kept on the power rectifier. After about six months of operation the division of current between some rectifier units changed. The rectifier still operated satisfactorily but the three units carrying less than their share of the current were replaced. Units were rearranged so that one new unit went into each phase. After the removal of the old units investigation showed their deterioration had been normal and there had been no real need for taking them out of service. The action was prompted by the fact that this was a new application.

We are well pleased with the performance of this new system.

WALKER SELENIUM RECTIFIERS
INSTALL THEM FORGET THEM
Engineered for Extra Years of
AC TO DC POWER CONVERSION

LOW COST, QUIET, HIGHLY EFFICIENT, LONG LIFE NO MAINTENANCE

Walker Selenium Rectifiers are engineered and built to give *extra* years of service and inexpensive operation. They are highly efficient, have a power factor of 97% and a DC ripple of approximately 4%. All Walker Rectifiers are low priced. Only the highest quality components are used. Any number of rectifiers may be paralleled. Write for full details, today.

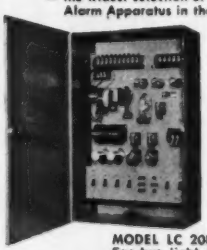
The Walker Division, Norma-Hoffmann Bearings Corporation

THE WALKER DIVISION
NORMA-HOFFMANN BEARINGS CORPORATION
Stamford, Connecticut

COMPLETE-PACKAGED . . .

OBSTRUCTION LIGHTING CONTROL and LAMP FAILURE ALARM UNITS
for unattended TELEPHONE COMPANY MICROWAVE RADIO-RELAY stations.

— by HUGHEY & PHILLIPS, INC.
— your most dependable source of Obstruction Lighting Equipment
— the widest selection of Control & Alarm Apparatus in the Industry.



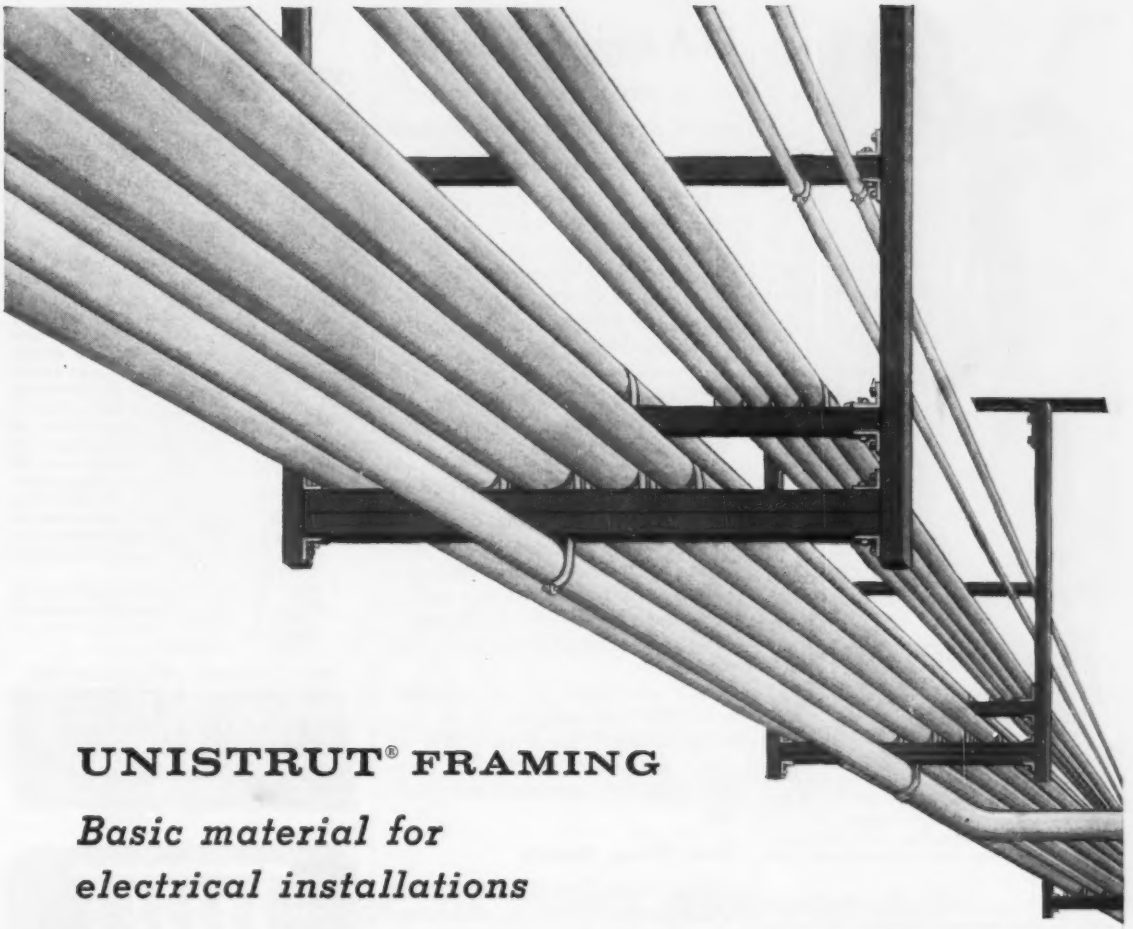
MODEL LC 2082
For two light levels

MODEL LC 2081 — for single light level
MODEL LC 2083 — for three light levels.

These units provide a separate signal for failure of each top lamp and include maintenance-test switches. Also available with photo-electric control for tower obstruction lights.

Write today for information regarding your specific problems.

HUGHEY & PHILLIPS, INC.
Manufacturers of
300MM Code Beacons, Obstruction Lights, Photo-Electric Controls, Beacon Flashers, Microwave Tower Control & Alarm Units Remote Lamp Failure Indicator Systems, and Complete Tower Lighting Kits.
3300 NORTH SAN FERNANDO BLVD.
BURBANK, CALIF.



UNISTRUT® FRAMING

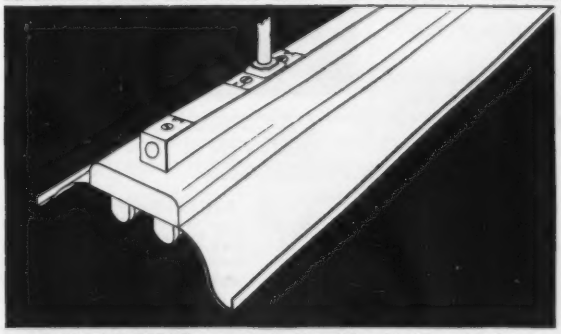
Basic material for electrical installations

World's Most Flexible All-Purpose Metal Framing.

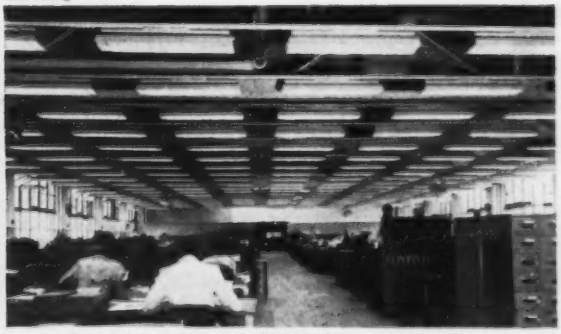
For supporting conduit and cable in any installation, UNISTRUT offers the quickest, simplest assembly. It makes a clean, professional installation and is strong enough to support the heaviest run. With UNISTRUT Channel and Concrete Inserts even the trickiest installation is simplified. Capacities may be easily expanded to take care of future growth. All types of fittings, clamps and brackets are available. See your UNISTRUT distributor. Write for new Bulletin FF-5.

UNISTRUT PRODUCTS COMPANY, Dept. W-5
933 W. Washington Blvd., Chicago 7, Illinois

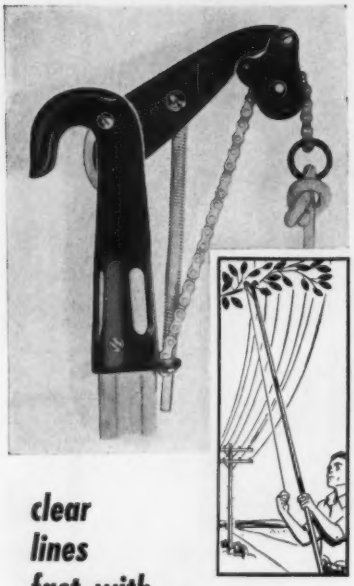
U.S. Patent Numbers 2327587 2329815 2388379 2363382 2345650 2541908 2405631 2696139 Other Patents Pending



The UNISTRUT system is listed by Underwriters' Laboratories, Inc. and may be used as a raceway.



Quickly installed, UNISTRUT Channel is rigid and strong, giving perfect, permanent alignment.



clear lines fast with...

SEYMOUR SMITH
"Telephone" Tree Pruner

Here's the standard, the choice of the utility industry for years. Powerful action to cut cleanly—tough and almost unbreakable—easy to handle. No. 12 Pruner Head has 1½" cutting capacity. The lighter, No. 11, handles up to 1" branches. Both are malleable iron castings with tempered steel cutting blade.

Poles (18 ft. 3 sections) are of selected spruce with positive locking, seamless aluminum, telescoping ferrule joints.

FAST CUTTING PRUNING SAWS

Designed for fast, easy cutting—large, deep teeth, finest Swedish charcoal steel, streamlined, laminated hardwood handles. Every model you need up to chain saw work.

No. 20 POLE SAW HEAD

Tough aluminum head with large hook and outside horn for pushing branches, raising wires, etc. Also paint brush holder with wire clamp that holds brush securely. Fast-cutting 16" blade. Poles available.

FREE: Send for Seymour Smith catalog pages on tools for utilities. Keep them on file for easy reference.

Quality Tools
SEYMOUR SMITH
Since 1850

SEYMOUR SMITH & SON, Inc.
2405 Main St., Oakville, Conn.

PEA Unit Supports

. . . standard "as found" meter report form which has been proposed by EEI

Support of a standard form on which to record "as found" meter accuracies was recently voiced at the spring meeting of the Pennsylvania Electric Association's meter committee, held in Pittsburgh.

The majority of PEA's 25 member companies favored putting into use the form proposed by Edison Electric Institute-Association of Edison Illuminating Companies.

Adoption of Form Sanctioned

Representatives of the companies stated that their organizations would be willing to adopt the EEI form as a basis for comparative studies and as a supporting basis for developing a petition for change in legal test periods.

This acceptance of the proposed form was announced by J. W. Althouse, Philadelphia Electric Co, as one of the conclusions of a study conducted during the committee's meeting.

Other Study Results

Other conclusions of the study which investigated the possibility of developing a standard form for recording "as found" meter accuracies are:

1. All reporting companies are now maintaining summary records.

2. There is no uniformity in the grouping of meters in summary reports.

3. Manhours devoted to the preparation of summary reports vary widely because of the volume of meters tested and the subsequent analysis of the reports.

4. Majority of reporting companies are testing meters in central or mobile shops.

Use of a newly designed 50-amp watt-hour meter with extended range to 200 amp was described by R. V. Kelch, Ohio Power Co. The instrument is enclosed in a matching enclosure. Meter terminals are prongs spaced to fit a molded terminal block. He said that Ohio Power has used the meter successfully in several installations. Cost of equipment and installation is about half the cost of using a lower capacity meter with current transformers.

Telemeter
ANY VARIABLE from Remote Points!

Accurate HIGH-SPEED Continuous
for POWER PRESSURE HUMIDITY POSITION VOLTS SPEED, ETC.

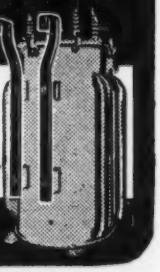
Telemeter transmitter converts DC mv from thermal converters, etc. to 10-30 cps which frequency modulates an audio tone channel. Receiver detects and demodulates transmitted signal, generating a DC mv for operation of recorders or indicating instruments. Up to 45 telemeters can be multiplexed. Any communication link, including power line carrier, may be used. Overall accuracy is 1% with a response speed of 1 sec.

Other terminals for teletype, voice-plus-control & data transmission are available.

Write for Technical and Application Data.

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

THIEL
TRANSFORMER HANGERS



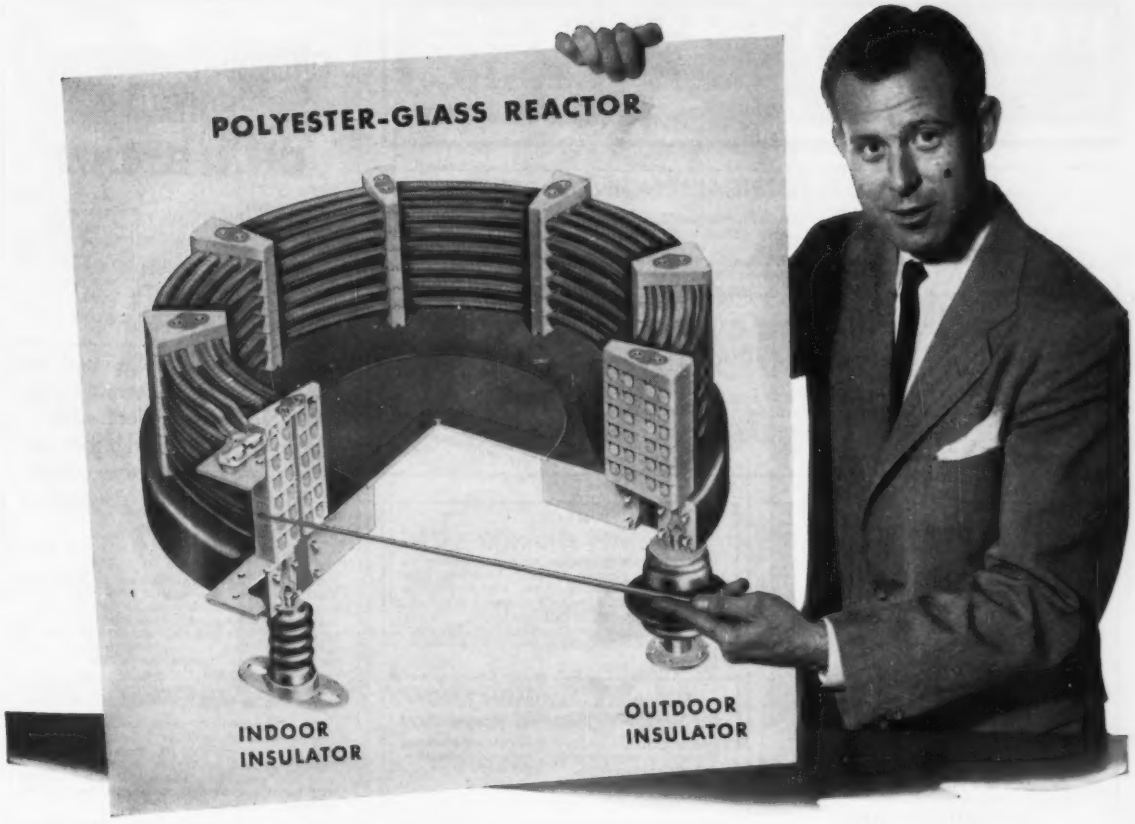
MODEL	C-1	C-3
TRANSFORMER	75-100 KVA Single-Phase	75-112½ KVA Three-Phase
WEIGHT	46 lbs.	100 lbs.

● Thiel Hangers are made according to NEMA specifications—heavy gauge steel construction, hot-dip galvanized for dependable service and long life. Two styles complete with galvanized bolts and nuts. In stock for immediate delivery.

T-TYPE HANGERS in two sizes. For 3-50 KVA 1-Phase and 9-45 KVA 3-Phase transformers.

HANGER KICKERS in sizes to fit T-type hangers.

THIEL TOOL AND ENGINEERING CO., INC.
1417 No. Market St. • St. Louis 6, Mo.



"Ageless" materials make new reactor stronger, lighter, more durable

The news in the new line of Westinghouse current-limiting reactors is a polyester glass that is stronger and lighter by far than any material used before in reactor construction. This polyester not only solves the aging and maintenance problem, but also permits a 30% reduction in reactor size and weight.

This new material provides these outstanding characteristics: (1) Exceptional mechanical and electrical strength—3 times the compressive strength and 10 times the tensile strength of concrete. (2) Great resilience to thermal and mechanical shocks—will withstand the forces generated by heavy short circuits and expansion of conductors during overloads. (3) Unequaled durability — polyester is impervious to moisture and all atmospheric conditions. Unlike concrete, it will not age or deteriorate under normal operating conditions.

The cleats are solidly bonded together by a special high-strength reinforced resin. This results in greater column strength and greater resistance to short circuit stresses between units—permits closer spacing between reactors, without the use of braces.

These new, smaller Westinghouse dry-type reactors are available in all ratings for indoor and outdoor service. For more complete information, call your nearby Westinghouse sales engineer, or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70753

YOU CAN BE SURE...IF IT'S
Westinghouse

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

DISPLAYED ——RATES—— **UNDISPLAYED**

The advertising rate is $19.15 per inch for all advertising appearing on other than a contract basis.
An Advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.
Subject to Agency Commission.

$3.50 per line, minimum 3 lines.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of ELECTRICAL WORLD, 330 W. 42nd St., N. Y. 36, N. Y.

SENIOR ELECTRICAL ENGINEER

Foreign Employment

Graduate EE with minimum 10 years' supervisory experience in utilities systems planning, study and design work. Must be generally familiar with power generation, transmission and distribution. For The Hague, Holland Engineering Office. Generous salary plus rent allowance. Liberal all-inclusive benefit program.

PROCESS ENGINEER

Graduate EE or ME with minimum 5 years' experience to handle technical aspects of power plant with gas combustion turbine integrated with steam plants, electrical motors, distribution and automatic control systems. 2 Years' supervisory experience desirable. For Operations Department located in Saudi Arabia. Generous salary plus living allowance: liberal all-inclusive benefit program.
Write giving full particulars regarding personal history and work experience.

Recruiting Supervisor, Box 148

ARABIAN AMERICAN OIL COMPANY

505 Park Avenue — New York 22, New York

ENGINEERS ELECTRICAL

COLLEGE GRADS

DESIGN

Seniors 8+ Juniors 2+ Years Experience

Relay—Application—
—System Planning—
5 + Yrs Experience

DISTRIBUTION AND TRANSMISSION

5 + Yrs Experience

Location New York—Permanent positions—long established service and supervisory organization for large group of Electric Utilities located Latin America. Some travel necessary future. Usual employe benefits. Reply stating age, education, experience, personal particulars and salary expected.

AMERICAN & FOREIGN POWER Co Inc and SUBSIDIARIES

2 Rector Street — New York 6, N. Y.
21st Floor — DI 4-4400 — Ext 8494

IMPORTANT TEACHING POSITIONS OPEN IN ISRAEL

Technion, Israel Institute of Technology, in Haifa, Israel, proposes to appoint:

Professor of Structural Engineering
Professor of Hydraulic Engineering
Professor of Mechanical Engineering
Professor of Mechanical Engineering with special qualifications in Machine Design and Applied Thermodynamics
Professor of Industrial Management and Production Engineering
Professor of Electronics
Professor of Mathematics

Applicants should have first-rate professional and academic qualifications, be willing to integrate themselves into the life of the country and, in due course, to teach in Hebrew.

Applications with full details should be sent in duplicate, for transmission to Haifa, to the:

AMERICAN TECHNION SOCIETY

1000 Fifth Avenue — New York 28, N. Y.

WANTED

SALES ENGINEER

with utility experience and the ability to handle all phases of new business connected with utilities. Age: Under 45. Liberal salary and traveling expenses.

P-1650, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER, ILLUMINATING

Lighting and Electrical Background

Dealing with outdoor lighting equipment. Salary commensurate with experience. Submit resume to:

P-1747, Electrical World
330 W. 42 St., New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITIONS VACANT

Sales Promotion Man. Management Consulting Firm in midwest has an opening for an alert journalism major, 25-30 years old, with some sales promotion or advertising experience in the utility field. Send detailed resume and salary requirements. P-1513, Electrical World.

Product Engineer—Graduate engineer with utility experience in transmission and distribution desired, for design and quality control with company manufacturing power line connectors, splices and deadends. Will work closely with sales and production departments as well as other engineers. We know this is the sale old ad, but it got us a good man last time, and he has been promoted. Salary open. Reliable Electric Company, 3145 Carroll Avenue, Chicago 12, Illinois.

Electrical Engineer, Graduate, five to ten years of work experience. Board work on illumination and power. Position available on staff of service organization of large office building in the Middle Atlantic Region. Please advise education, experience, and salary expected. Reply held confidential. P 1820, Electrical World.

State of Connecticut has an immediate opening for Senior Design Engineer (Electrical), salary range $5,760-$8,160. Ten years engineering experience or college graduation in engineering and six years of engineering experience is required, including four years in electrical design of large building projects or utilities. Apply to State Personnel Director, Room 405, State Office Building, Hartford, Connecticut.

GOVERNMENT OF VICTORIA AUSTRALIA

CHAIRMAN

State Electricity Commission of Victoria

Applications are invited for the position of Chairman of the State Electricity Commission of Victoria. The present maximum salary provided under current legislation is £6,000 (Australian currency) per annum.

Each applicant is required to state his qualifications, experience and age. The term of appointment will be for a period not exceeding seven years, with the right to apply for re-appointment at the end of the term. The successful applicant will be required to devote his whole time to the service of the Commission, and must not engage in any employment other than in connection with the duties of his office.

The Commission was formed in 1919, and is a statutory body functioning under Act of Parliament. It consists of four Commissioners, of whom three serve in a part-time capacity. The selected appointee will be the executive head of the undertaking.

The Commission operates a State-Wide system of power stations, transmission lines and distribution networks. It produces 99 per cent. of the electricity used in Victoria and supplies direct, or through municipalities receiving bulk supply, about 750,000 consumers. The principal steam station is at Yallourn, and it uses raw brown coal won by open cut methods from extensive adjacent deposits operated by the Commission. Other steam stations use, in addition to raw brown coal, black coal, oil and brown coal briquettes manufactured by the Commission at its Yallourn briquette factory. There are hydro-electric stations at Kiewa, Eildon and Rubicon. The installed capacity of the generating system is nearly 1,000 megawatts, and at the present rate of demand growth it will be necessary to at least double the generating capacity during the next decade.

An intensive construction programme, involving the expenditure of over £20 million per annum for many years, is now in hand, including the enlargement of the Kiewa Scheme, the new Eildon Power Station, extension of the Yallourn Power Station, and a major expansion of the briquetting industry, coupled with power plants based on a new open cut at Morwell. The existing assets of the Commission total over £200 million; its present revenue is about £29 million per annum. It employs over 18,000 persons.

Additional information regarding its activities may be obtained on application to the undersigned, or to the Agent-General for Victoria, Victoria House, Melbourne Place, The Strand, London or the Australian Embassy, 1700 Massachusetts Avenue, Washington, D. C. U.S.A.

Applications, accompanied by copies of references, should be submitted in writing to the Minister of Electrical Undertakings, 22-32 William Street, Melbourne, C.1., not later than 15th June, 1956.

G. O. Reid

MINISTER OF ELECTRICAL UNDERTAKINGS

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES · EQUIPMENT - USED or RESALE

RATES

UNDISPLAYED

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

DISPLAYED

The advertising rate is $14.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISING to N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y. for June 11th Issue closing May 31st

---

REBUILT AND NEW

GUARANTEED

MOTORS

MG SETS

GENERATORS
TRANSFORMERS
HOISTS • PUMPS
COMPRESSORS

UNITS OF EVERY SIZE AND DESCRIPTION

WE SELL, BUY OR TRADE

Phone CAnal 6-2900

CHICAGO *Electric Co.*

1324 West Cermak Road
Chicago 8, Illinois

FOR SALE
SUBJECT TO PRIOR SALE

200 Westinghouse Type CO, Inverse Time Relays, Rated 0.5/2.5 Amperes, 60 Cycle, with Universal Operation Indicator. In Modern Flexitest Cases Which Can Be Mounted Either Flush or Projection. All In First Class Condition. Can Be Used Interchangeably. Styles Nos. 1271197, 1273197, 1545024 and 1545012. If Interested Contact N. C. Stirewalt, V. P., Central Illinois Public Service Company, Springfield, Illinois.

UNIT SUBSTATION

1000 KVA GENERAL ELECTRIC UNIT SUBSTATION, Type HTU, Three Phase 12000 Volts to 2300/4000 Volts, with 2-2½% Tap Above & Below H.V. Excellent Condition Low Price

750 KVA WESTINGHOUSE THREE PHASE TRANSFORMER, Type SL, 4160/7200 to 2300/4160 Volts — Modern

TIPPINS MACHINERY COMPANY
1001 Washington Blvd. Pittsburgh 6, Pa.

CONTRACT WORK WANTED

British Public Company with wide production facilities in light engineering, electrical, electronic fields interested in contacting an American Company with view to manufacturing new products for United Kingdom market.

CW-1761, Electrical World
330 W. 42 St., New York 36, N. Y.

FOR SALE

Modern Power Plant 2500 KVA GE Turbine Generator 3/60-230/4160 volt, 400= 750° FTT, complete with boiler, superheater, economizer, condenser, boiler feed pump, feed water heater Hagen Combusion Control.

ELECTRIC EQUIP. & ENGR. CO.
Box 6597 Denver 16, Colo.

MOTORS · GENERATORS
TRANSFORMERS
NEW • REBUILT
WORLD'S LARGEST INVENTORY
ELECTRIC EQUIPMENT CO.
PHONE STATION COLLECT GL 6781
P.O. BOX 21 ROCHESTER 1, NEW YORK

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4699) will be received at Denver, Colorado, until July 3, 1956, for furnishing radio communication equipment for Missouri-Oahe District, South Dakota, and first addition to Missouri-Souris District, North Dakota, Missouri River Basin Project. Delivery is desired within 150 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

If there is anything you want
that other readers can supply
OR . . . something you don't want—
that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

TRANSFORMERS

SPECIAL PURCHASE

five carloads
13800 volt transformers
sizes 25 KVA to 250 KVA
new and slightly used

What can you use?
Write for list and prices

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
5316 Hetzel St.
Cincinnati 27, Ohio

40 Years' Dependable Service

ELECTRICAL
WIRE AND CABLE

—YOUR BEST SOURCE—

• for every industrial and power application
• Odd lengths—long and short—reasonably priced

One of the Largest Stocks in the Midwest

Let us quote on requirements—
send your inquiries
We'll also buy your Surplus

Branch Office:
Houston—Walnut 3-4580
FOR YOUR TEMPORARY NEEDS TRY OUR SURPLUS DIVISION

UNIVERSAL WIRE and CABLE Co.
2929 N. Paulina St. Chicago 13, Ill.
EAstgate 7-4777 Code: UNIWIRE

SUBSTATION EQUIPMENT

TRANSFORMERS

QU.	KVA	MFGR.	VOLTAGE
4	2500	Mol.	66,000—13800
1	2000	G.E.	66,000—2300/4000Y, 3 ph.
3	1500	G.E.	66,000—2400/4160
3	200	Pitts.	66,000—2300
3	1500	Wag.	44,000—6900/11950
3	1250	A.C.	44000/11500—460
3	75	West.	44,000—7200/12470Y
3	5000	G.E.	38100/66000—6600
4	3333	G.E.	38100/66000Y—33000
4	3125	Mol.	39900/66000Y—26600/46000Y
3	3333	G.E.	33000/11000—2400/7200
1	3000	A.C.	34500—2400/7200/12470Y, 3ph
2	3000	Stand.	33000—4160, 3 ph.
1	2000	Kuhl.	33000—6900, 3 ph.
3	1500	A.C.	34,500—2300
3	667	A.C.	33000—2400/4160Y
4	333	Kuhl.	33000—7200/12470Y
3	200	A.C.	34500—2400/7200/12470Y
3	200	G.E.	34500—120/240
3	75	Wag.	33000—240/480
4	1500	A.C.	25400/44000Y—6900/13800
3	100	G.E.	22000—7200/12470Y
3	50	G.E.	22000—2300
2	3000	G.E.	13800—600, 3 ph. Unit Sub.
3	1200	West.	13800—600, 3 ph. Unit Sub.
1	1000	West.	13200—2300, 3 ph. Unit Sub.
1	1000	A.C.	13800—480, 3 ph.
1	600	Stand.	13200—2300 3 ph.
1	450	Penna.	13200—2400, 3 ph. ASKAREL
3	200	G.E.	13200—2400
1	2500	A.C.	11,000—2400/4160Y, 3 ph
1	1500	G.E.	11,500—4000, 3 ph.
3	125	A.C.	6900—2300
3	333	G.E.	2400/4160Y—460
3	250	Mol.	2400—240/480
3	200	West.	2400—240/480
3	150	West.	2400—230/115
3	100	G.E.	2400/4160—120/240
1	100	G.E.	2300—575, 3 ph.
6	50	West.	2400—114/228, Dry Type

ALSO: FREQUENCY CHANGERS
MOTOR GENERATOR SETS
SYN. CONDENSERS
OIL CIRCUIT BREAKERS
FEEDER REGULATORS, ETC.

BREW, WOLTMAN & CO., INC.
52 Church St. New York 7, N. Y.

LARGE POWER EQUIPMENT

Prompt Stock Shipment

RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?

BELYEA COMPANY INC.
51 Howell St. Jersey City, N. J.

DIESEL ENGINES — POWER MACHINERY

DIESEL GENERATOR SETS—Stationary—Portable—Mobile
MOTORS and GENERATORS—100 KW to 1500 KW

A. G. SCHOONMAKER COMPANY, INC.
Main Office Box 516, Sausalito, Calif. Sausalito 1500
Branch 50 Church St., N. Y. 7, N. Y. Digby 9-4350

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

PUAA Hears Vennard

(*Continued from page* 121)

can get it for less," he observed.

"When American people find out about this," said Vennard, "they will insist that this nonsense be stopped."

"It is difficult to inform people respecting this problem, we must keep at it diligently if we are to preserve our way of life. It is a big job but we are dealing with a big issue," he said.

Bridges Named President

There was a record attendance of 325 delegates and their wives at the meeting. Robert H. Bridges, advertising manager, Cleveland Electric Illuminating, was elected president of PUAA succeeding Raymond W. Fenton, manager of advertising, Peoples Gas Light & Coke Co.

Other officers are: First vice president—Richard D. Furber, director of public information and advertising, Northern States Power Co; second vice president—George W. Kindon, supervisor of advertising, Philadelphia Electric Co; third vice president—Warren W. Widenhofer, public relations director, Indiana & Michigan Electric Co; secretary—George G. Hanel, manager, advertising and publicity, Connecticut Light & Power Co; and treasurer—Mead Schenk, director of public information, Interstate Power Co.

Trapnell Gives Warning

Edward R. Trapnell, consultant, Nuclear Energy Division, Bozell & Jacobs, warned of the drive to put the government in the nuclear power business. He cited these arguments being advanced by proponents of government nuclear power development:

1. Privately sponsored development is hung upon one problem or another.

2. Additional types of reactors should be tested in large scale plants built by the government.

3. National prestige demands a world-impressing demonstration which only the government can put across.

4. We will lose world markets if we fail to display a massive accomplishment that provides experience for our manufacturers on a scale which only the government can afford to back with dollars.

The development of motion pictures as a promotion tool was described by Frank Siedel, president, Storycraft, Inc, of Cleveland. In 1955, he noted, $70 million was spent on business films, and this year, the figure is expected to go to $100 million.

Storycraft supplied the script for the highly successful "Land of Promise" motion picture used by Cleveland Electric Illuminating to attract new industry.

The advantages of motion pictures are obvious, said Siedel. "They compress or extend time. They show what cannot be seen. They can magnify or minimize. And above all, they command undivided attention without distraction."

The minimum cost today for motion picture production, he said, could be figured at $1,000 per minute. To this would have to be added other costs. A more realistic way of determining cost, Siedel contended, is on a per viewer basis. These could range from mills per viewer up to four or five cents per viewer.

Business Films Can Oversell

But he warned delegates against using motion pictures to oversell. "We don't have to beat the drums. It is important that we tell the truth but it is important that we don't overdo to the point where people don't believe us. The business film is too big an investment to get clever with," said Siedel.

"Getting the Most Out of Television" was the subject of Edward F. Lethen, Jr, manager, Network Sales Development, CBS Television. He cited these factors as the best way to get the most out of television:

- Buy carefully and wisely.
- Make good and careful use of your commercial messages.
- Have enough advertising.

Lethen noted that network costs for commercials vary, but in general a cost of $3 per thousand homes is considered good. As a rule of thumb, these costs could be used: $1 per thousand for short spot announcements; $2 per thousand for 20 seconds; and $3 per thousand for one minute.

Don't Forget Commercials

The television executive pointed out that mornings and afternoons offer easy and economical time to reach people at costs less than night time. He said more attention should be paid to commercials. "Tell listeners the things that they want to hear. Stay away from pet ideas of what you think listeners ought to be told. And use small words with big meanings."

Many commercials violate the rules of good advertising, said Lethen. Too many sounded as if they were written to be read instead of spoken. The language should be simple and direct, and personal reference should be used.

To increase the effectiveness of television advertising, he suggested that utilities use their associations to make television commercials available in a similar manner as a mat service. But above all, the commercials should be believable, understandable, and simple.

Getting Started in TV

Television has excellent potential as a community advertising medium for utilities, said Lloyd E. Yoder, president and general manager of NBC's radio and television stations in Philadelphia.

Television has three special advantages to utilities, Yoder added. These are:

- It reaches the entire public.
- It is far and away the most effective medium for demonstration.
- It is the most personal of the media.

There are two ways to get started in television. This could be either with a schedule of spot announcements, permitting flexibility to move around in the beginning, or with a full program.

"Eventually, some form of identification with a program—either through participation or through full sponsorship—should be your primary tool. Because programming is the best way to identify yourself with the community and its interests—the best way to emphasize your desire to serve the public and serve them well," said Yoder.

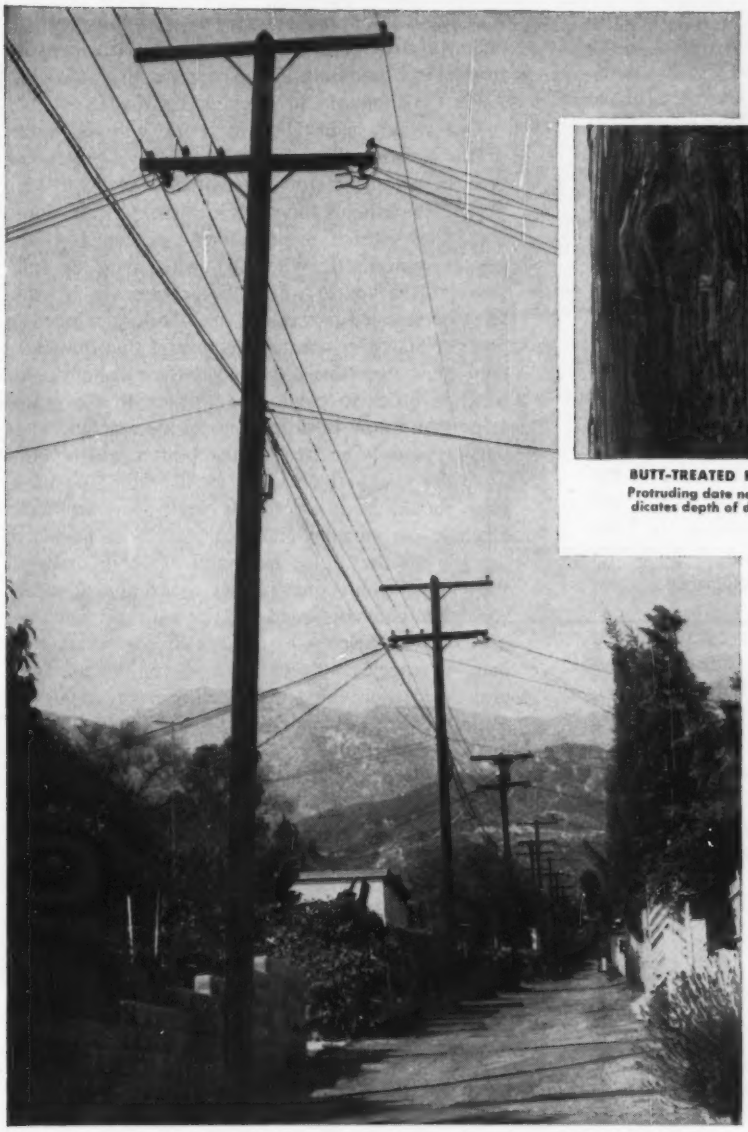
Selecting a TV Program

Care should be used in the selection of the program. Yoder maintained that "viewers seem to expect a public utility to take part in some form of community service-type programming."

There are many possibilities, besides cooking shows, news, and weather shows. There are, for example, plenty of good syndicated films. "There are those in television who are convinced that a good children's show would be a natural for public utilities," he said. Other possibilities include special programs covering actual events such as local elections, county fairs, sports events, and forums dealing with community problems, added Yoder.

"Full-length Pressure-Creosoting solved our problem"

says W. H. Keating Burbank Public Service Department



BUTT-TREATED POLE
Protruding date nail indicates depth of decay

FULL-LENGTH, PRESSURE-CREOSOTED POLE
Pole still sound after 26 years' service

Over 26 years ago, the Public Service Department of Burbank, California, changed to full-length pressure-creosoted poles due to premature failure of the aboveground portion of the butt-treated poles they had been using. They were quick to recognize the superiority of *pressure treatment* with *creosote* as the solution to their costly pole replacement problem.

The 26-year-old pole line shown at left is typical of the increased service life which they are now obtaining with full-length pressure-creosoted poles. According to W. H. Keating, Burbank's Electrical Supervisor, these poles are as sound today as when originally installed.

But even 26 years' service is not too much to expect from pressure-creosoted poles. Creosote is well known as the "30-year-plus" preservative. You can get this quality protection and long life for your poles by specifying *pressure treatment* with creosote—*the proven preservative*. Tar Products Division, Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

FOR THE LIFE OF YOUR POLES, ALWAYS SPECIFY CREOSOTE

KOPPERS

CREOSOTE

TAR PRODUCTS DIVISION

DISTRICT OFFICES:

Woodward, Alabama
New York, N. Y., 430 Park Avenue
Los Angeles 5, Calif., 3450 Wilshire Blvd.
Chicago, Ill., 122 S. Michigan Ave.
Boston, Mass., 250 Stuart Street
Pittsburgh, Pa., Koppers Building

READERS FORUM

House Heating Lesson Forgotten

To the Editor:

We are manufacturers of electric heating equipment, and the writer is an engineer associated with electric heating both here and in the United States since 1948. I cooperated with your Mr Frank R. Innes in the early developments of Glassheat in the United States prior to establishing our business in Canada.

During those days—in cooperation with Mr William S. Leffler of Norwalk, Conn.,—we arranged for a test house on the Hartford Electric lines, and at that time decided that the house load must be controlled and not superimposed upon electric heating.

I write this letter to you because I am very interested in the future of electric heating and wish to commend you on the job that Electrical World is doing in compiling the facts and presenting them to the world at large. But it disturbs me to read in all these surveys that the lesson learned at the Hartford test house has gone to waste, and I still see figured such demand responsibilities as 10.2 kw for a range, 4.56 for a clothes dryer, 3 for a hot water unit, and 4.5 for a high-wattage hot water unit.

In Canada, all of this is taken care of by a 40-amp breaker. Through our thousands of installations we have experienced nothing but satisfaction, and we limit our house demand load (excluding electric heat) to 4.5 kw which when diversified with electric heating shows diversity factors far and above those published.

Arthur B. Johnson
Vice President

Electroheat Limited
Montreal, Canada

Encouraging Use of Safety Goggles

To the Editor:

In the Electrical World of March 19, we took note of your How item covering the development by the meter department of Texas Electric Service Co in which it devised a method of assuring that grinder operators wear goggles.

We would like to point out that the Forth Worth people included a toggle switch in series with the grinder and safety switch. This you realize provides for a condition under which the goggles may be left off of the safety switch and the grinder controlled from the toggle switch. In this event the goggles may be permanently misplaced, and the continued stop and start operation of the grinder be made through the toggle switch.

However, what I would like to bring to your attention is this: A safety switch assuring the use of goggles with a grindstone was developed by Mr R. Crowle and myself in the fall of 1953. A patent was applied for in the spring of 1954 through the office of Bishop, Bishop, and McKenzie patent attorneys in Edmonton. The patent switch was applied for in the name of Christophers & Crowle.

Our switch is installed in series with the motor of the grindstone and has the following features: A push button to stop the motor, a keyed locking device which holds this button in the "off" position, and a key which is permanently fastened to the goggle frame itself. When the switch is in the "off" position, the key to which the goggles are fastened must be inserted in the lock and the lock tripped in order to start the motor. This insures that the workman must necessarily have had the goggles in his hand in order to commence work with the grindstone. And now in order to stop the machine after having used it he presses the button which automatically locks the switch in the "off" position. Now should he inadvertently walk away from the machine carrying with him, or otherwise misplace, the goggles they must be found again in order to start the machine thus further assuring that safety is going to be a continued practice with this machine.

It may be also pointed out that any number of pairs of goggles may be used in conjunction with said grinder provided that each pair of goggles is equipped with a duplicate key permanently fastened to the frame of the goggles.

Our switch may be used in conjunction with any type of electrical machinery which requires the use of goggles or other safety equipment.

N. J. Christophers

12445-80th Street
Edmonton, Alberta

Liked Rural Market Issue

To the Editor:

You and the other editors of Electrical World seem to have a talent for putting your fingers on data that have a wide interest for all sections of the electric industry and then presenting the story in such a way that it will be useful reference material for many people. I refer in particular to the article in the Feb. 13 issue on "The Changing Rural Market."

Congratulations on treating a difficult subject in a fine way.

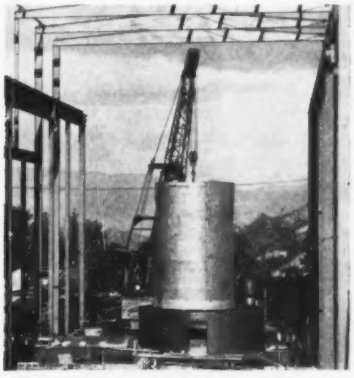
A. Callaway Allen
Sales Manager, Electrical Division

Wagner Electric Corp
Saint Louis, Mo.

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Principal Technical Details of the Sodium Reactor Experiment in California

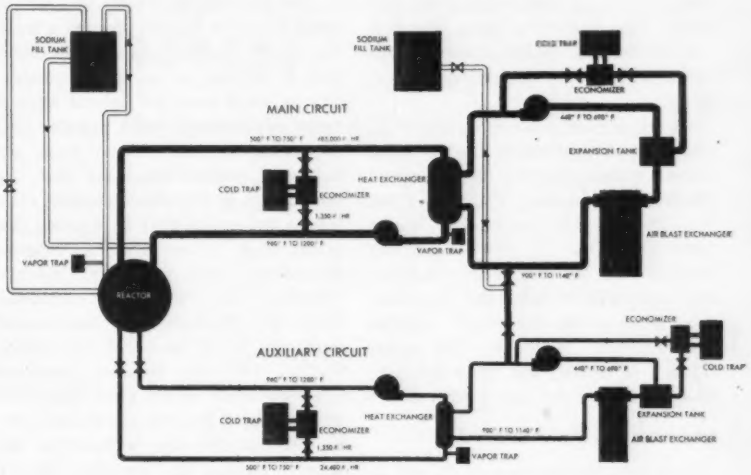
The Sodium Reactor Experiment is an important contribution to the Atomic Energy Commission's program to develop economical power from nuclear energy. Interest in the SRE approach is high. The Atomic Energy Commission has authorized ATOMICS INTERNATIONAL and the Southern California Edison Company to enter into an agreement for Edison to install electrical generating equipment with a capacity of 7,500 kilowatts adjacent to the SRE to convert the reactor's 20,000 kilowatts of heat into electricity which will be fed into the utility's power grid system. ATOMICS INTERNATIONAL and the



SRE reactor core is lowered into place deep in the Santa Susana Mountains

Consumers Public Power District of Nebraska are negotiating for the construction of a 75,000 kilowatt nuclear power plant utilizing a sodium graphite reactor based on SRE experience.

The Sodium-Cooled, graphite-moderated reactor design has many advantages. The use of sodium permits high temperature operation, good steam conditions and high thermal efficiency of power conversion without pressurization of the reactor and coolant circuit. The high thermal conductivity of sodium makes it an excellent heat transfer medium. Sodium boils at 1620°F.—is liquid at 208°F. This permits high coolant temperatures with the system at atmospheric pressure, creating a low-pressure heat extraction system which simplifies reactor construction. Further, the sodium design minimizes chemical reaction between fuel elements, coolants and structural materials—increases safety—allows the use of a variety of steels and alloys in construction.



Sodium Flow Diagram For SRE Cooling System

Nominally Rated Output of SRE with Uranium fuel (enriched with 2.80 atom percent U235) is 20 Thermal Megawatts. The reactor core is made up of fuel rods, moderator cans and control elements interspersed and immersed in sodium coolant. The fuel is composed of 6 inch slugs, 0.750 inches in diameter, formed in 6 foot columns tied in clusters of seven. The graphite moderator elements are canned in Zirconium, fabricated with an axial coolant channel. This prevents absorption of sodium into graphite. Much less costly than beryllium—graphite is also comparatively easy to handle.

Capital and Power Costs in Full Scale Power Stations—At present, with Uranium fuel, capital costs/installed Kw. are expected to total $300. With Thorium, costs may be $265/installed Kw. Power costs (based on 80% load factor and 15% annual fixed charges) may be 11 mills/kwh with Uranium, 9 mills with Thorium. Future costs with Thorium fuel are expected to be $200/Kw capital cost and 6.5 mills/kwh total power costs.

Atomics International is a major reactor builder—experienced in the design, construction and operation of nuclear reactors for research and the production of power. If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. EW-N2, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

Ohio PUC Grants Depreciation Order

Commission reverses previous order to Cincinnati G&E in same case; orders use of the tax reserve method for accelerated depreciation

The Ohio Public Utilities Commission has granted the Cincinnati Gas & Electric Co a liberalized depreciation order. This new order dated March 6 has reversed an earlier order of Sept 12, 1955 denying a similar application.

In the present proceeding the PUC said: "In an application on the same subject matter filed by the Cleveland Electric Illuminating, P.U.C.O. Case No. 25,731, the commission, in its order dated Dec. 29, 1955, was of the opinion that the tax reserve method was preferable to either the Depreciation Reserve or Restricted Surplus (capitalization) methods. The commission is still of the same opinion, as applicable to the facts in this case."

Methods to Be Adopted

The commission went on to say in its findings "that the Internal Revenue Code permits the taxpayer to adopt one of the several methods of accelerated depreciation with respect to facilities constructed, reconstructed, or acquired and initially used after Dec. 31, 1953.

"The adoption of a method of accelerated depreciation for income tax purposes will result in reducing in the early years of the life of the property certain amounts of federal income taxes with respect to the property affected. The amount and extent of such net difference in taxes will depend upon the nature and the volume of the facilities from time to time added to the taxpayer's plant, and the election of the taxpayer as to whether certain of these facilities shall be subject to accelerated depreciation."

The PUC continued in its order "that if the applicant elects to adopt one of the methods of accelerated depreciation, it should be required to appropriately account for and to use the funds resulting from the reduction of taxes, and such funds should not be available for the payment of dividends."

The commission order further said: "That the appropriate accounting treatment is to make an additional charge to operating expense annually in the amount by which federal income taxes for the year resulting from the election of accelerated depreciation in respect to any of its properties, is lesser than the federal income taxes which would have resulted had the company not elected such accelerated depreciation and that the application in the above entitled matter, to the extent that it requests this commission to establish accounting procedures (with respect to the tax "Savings" or "Deferrals" resulting from the application of accelerated depreciation as provided for under Section 167 (b), Internal Revenue Code of 1954) in the event said Cincinnati Gas & Electric Co should elect to utilize accelerated depreciation for federal income tax purpose, should be granted, and in all other respects where said application varies from the terms of this order said application should be denied."

Requirements of Applicant

In its order the PUC noted that the applicant be required:

1. "To account on its books for that portion, of its properties which are the subject of accelerated depreciation pursuant to its election under Section 167 of the Internal Revenue Code of 1954 in the same manner as its other properties, and to accrue depreciation therefor at rates consistent with its rates for like property not subject to accelerated depreciation.

2. "During those years of the service life of any of its properties which are the subject to accelerated depreciation pursuant to its election under Section 167 of the Internal Revenue Code of 1954, in which a reduction of federal taxes on income results from the use of the accelerated depreciation deduction in lieu of the deduction allowable under the tax depreciation method heretofore followed, to charge to "Provision for Future Federal Income Taxes," a subaccount under "Taxes", and to credit to "Reserve for Future Federal Income Taxes", an amount or amounts in total for each year equal to such reduction of taxes.

3. "Commencing with the year in which its deduction of depreciation for federal tax purposes in respect of any of its properties subject to accelerated depreciation is less than such deduction otherwise would have been if depreciation on such properties had been computed at rates consistent with its depreciation rates for federal tax purposes for like properties not subject to accelerated depreciation, to charge to "Reserve for Future Federal Income Taxes" and to credit to "Provision for Future Federal Income Taxes," a subaccount under Taxes, an amount or amounts in total for each year equal to the increase in federal income taxes resulting from such lower federal tax depreciation deduction."

It is significant that the present order made no reference to the PUC's earlier claim that the tax deferral was in effect a permanent reduction in taxes.

REGULATION BRIEFS

Columbus & Southern Ohio Electric Co has received the Public Utilities Commission of Ohio approval to increase its rural rates by $145,800 a year.

Lawrenceburg, Tenn., Power Board will remove after June 1 the 10% surcharge made to commercial users of power in Lawrence County. It will amount to $16,000 a year. No surcharge has ever been applied to residential users in the county.

Arkansas Public Service Commission's refusal to grant a rate increase of about $8 million to Arkansas Power & Light Co in 1954 was upheld recently by the Arkansas Supreme Court (EW, 4/9, p 63).

(*Continued on page* 264)

This announcement is neither an offer to sell nor a solicitation of an offer to buy any of these Debentures. The offer is made only by the Prospectus.

$300,000,000

GENERAL ELECTRIC COMPANY

Twenty Year 3½% Debentures Due 1976

Dated May 1, 1956 — *Due May 1, 1976*

Interest payable May 1 and November 1 in New York City

Price 100½% and Accrued Interest

Copies of the Prospectus may be obtained from only such of the undersigned as may legally offer these Debentures in compliance with the securities laws of the respective States.

MORGAN STANLEY & CO. — *GOLDMAN, SACHS & CO.*

DILLON, READ & CO. INC. — *THE FIRST BOSTON CORPORATION* — *KUHN, LOEB & CO.*

BLYTH & CO., INC. — *DREXEL & CO.* — *EASTMAN, DILLON & CO.*

GLORE, FORGAN & CO. — *HARRIMAN RIPLEY & CO. Incorporated* — *KIDDER, PEABODY & CO.*

LAZARD FRERES & CO. — *LEE HIGGINSON CORPORATION*

LEHMAN BROTHERS — *MERRILL LYNCH, PIERCE, FENNER & BEANE*

PAINE, WEBBER, JACKSON & CURTIS — *SALOMON BROS. & HUTZLER*

SMITH, BARNEY & CO. — *STONE & WEBSTER SECURITIES CORPORATION*

UNION SECURITIES CORPORATION — *WHITE, WELD & CO.*

May 15, 1956.

Regulation Briefs

(*Continued from page* 262)

Long Island Lighting Co has asked the New York Public Service Commission for approval to withdraw its request for $1,224,356 a year rate increase. Company said that a "satisfactory" increase in revenues during the first quarter of 1956 makes the higher rates unnecessary.

FINANCIAL BRIEFS

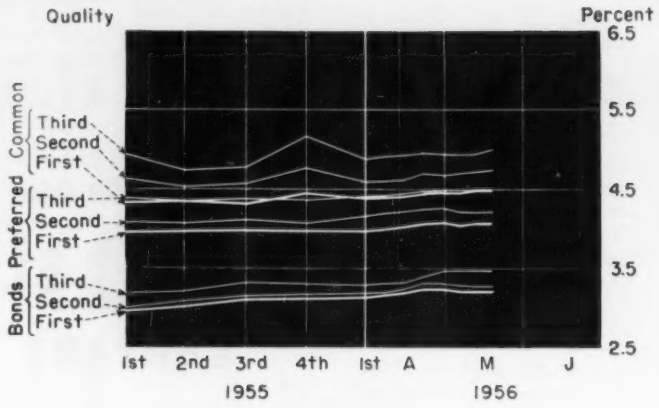
Sierra Pacific Power Co is offering its holders of 35,000 shares of outstanding 6% $100 par preferred stock to exchange their stock on a 2.3-for-1 basis, for 80,500 new Series A $50 par $2.44 preferred stock. Offer expires June 5. Stock not converted will be called for redemption on June 8. After this transaction the company plans to offer to its commonholders the right to subscribe to 62,576 common shares on a 1-for-10 basis.

Coming Issues—Potomac Electric Power Co will sell competitively $10 million first mortgage bonds due 1991 and will offer 281,435 common shares to stockholders on a 1-for-20 basis . . . Pacific Gas & Electric Co is planning to offer its commonholders rights to subscribe to 812,791 common shares on a 1-for-20 basis to stockholders of record June 12 . . . **Virginia Electric & Power Co** directors have approved "in principle a plan to sell $20 million first mortgage bonds through competitive bidding on Sept. 25" . . . **Connecticut Power Co** will sell 104,000 shares of $50 par cumulative preferred stock to the public through Putnam & Co and Chas. W. Scanton & Co underwriters. Company will also offer to its commonholders the right to subscribe to 71,132 common shares on a share for share basis.

Virginia Electric & Power Co will pay June 20 a quarterly common stock dividend of 45¢ a share as compared with 40¢ in the previous quarter.

Southern Co system will spend more than $700 million in the next six years, Chairman E. A. Yates predicted at annual stockholders meeting recently. He estimated Southern Co will invest $150 million in its subsidiaries during next six years.

Today's Utility Yields (%)



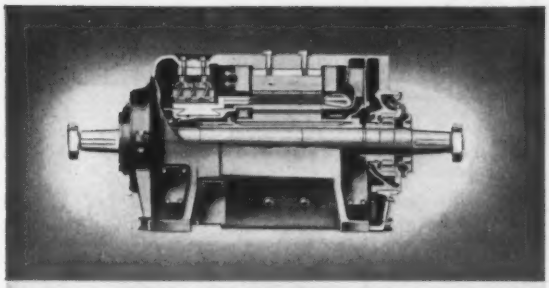
	BONDS			PREFERRED STOCKS			COMMON STOCKS		
QUALITY.....	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
May 17.....	3.22	3.28	3.48	4.10	4.24	4.49	4.49	4.76	5.05
May 10.....	3.22	3.28	3.48	4.10	4.24	4.50	4.50	4.74	4.97
May 3.....	3.22	3.29	3.48	4.08	4.25	4.50	4.48	4.71	4.98

Utility Earnings

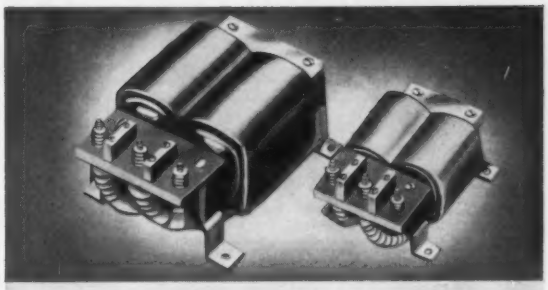
COMPANY	PERIOD MONTHS	ENDED	NET INCOME 1956	NET INCOME 1955	EARNINGS PER COMMON SHARE 1956	EARNINGS PER COMMON SHARE 1955
Alabama Power	12	Mar.	$14,416,375	$13,223,961	$....	$....
Arizona Public Service	12	Mar.	5,580,000	5,039,000	1.43(a)	1.51(a)
Arkansas Power & Light	12	Mar.	7,468,223	8,866,280	....	....
Carolina Power & Light	12	Mar.	9,697,883	8,297,118	1.68(b)	1.53(b)
Central Illinois Electric & Gas	12	Mar.	761,590	621,376	2.21	1.82
Central Illinois Light	12	Mar.	4,513,516	3,651,551	4.01	3.15
Central Maine Power	12	Mar.	6,525,589	6,355,929	1.70	1.65
Central Vermont Public Service	12	Mar.	1,347,328	1,422,423	1.22	1.32
Consumers Power	12	Mar.	30,256,924	27,135,619	3.28(a)	3.03(a)
Dallas Power & Light	12	Mar.	7,204,687	6,499,073	....	....
El Paso Electric	12	Mar.	2,215,383	2,170,105	2.48	2.43
Georgia Power	12	Mar.	14,313,031	12,926,174	....	....
Gulf Power	12	Mar.	2,628,310	2,136,473	....	....
Gulf States Utilities	12	Mar.	10,647,812	9,599,641	2.16	1.91
Houston Lighting & Power	12	Mar.	15,740,643	13,151,807	2.63	2.19
Middle South Utilities, consolidated	12	Mar.	17,106,209	16,485,708	2.25	2.17
Minnesota Power & Light	12	Mar.	4,265,394	3,544,666	2.15	1.73
Mississippi Power	12	Mar.	2,333,749	2,112,644	....	....
Mississippi Power & Light	12	Mar.	4,278,986	3,884,730	....	....
New York State Electric & Gas	12	Mar.	11,072,292	9,582,345	2.84(c)	2.63(c)
Oklahoma Gas & Electric	12	Mar.	8,593,429	7,414,017	2.20(f)	2.26(f)
Pennsylvania Power & Light	12	Mar.	22,714,916	21,688,954	3.19	3.03
Quebec Power	3	Mar.	280,871	263,119	0.42	0.39
Shawinigan Water & Power	3	Mar.	2,637,672	1,957,708	0.98	0.70
Southern Co, consolidated	12	Mar.	27,351,240	23,496,930	1.39(g)	1.30(g)
Southern Indiana Gas & Electric	12	Mar.	2,354,897	2,620,624	1.95(h)	2.42(h)
Texas Electric Service	12	Mar.	11,236,175	10,363,694	....	....
Texas Power & Light	12	Mar.	10,725,510	10,164,647	....	....
Texas Utilities, consolidated	12	Mar.	24,916,731	23,130,335	2.04(i)	1.96(i)
Tucson Gas, Electric Light & Power	12	Mar.	1,856,943	1,919,820	1.70	1.76
West Penn Electric, consolidated	12	Mar.	17,685,817	16,194,636	2.09	1.91

Notes—(a) Based on average shares; (b) Based on 4,830,000 shares in 1956 and 4,600,000 shares in 1955; (c) Based on 3,337,475 shares in 1956 and 3,034,068 shares in 1955; (f) Based on 3,283,262 shares in 1956 and 2,723,055 shares in 1955; (g) Based on 19,594,946 shares in 1956 and 18,087,643 shares in 1955; (h) Based on 996,363 shares in 1956 and 913,333 shares in 1955; and (i) Based on 12,210,000 shares in 1956 and 11,810,000 shares in 1955.

How you profit by using



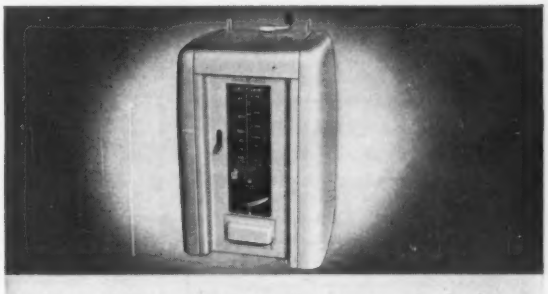
G-E CLASS H INSULATION protects all coils in this rugged mill motor: silicone-treated mica mat on armature, commutating and exciting field coils; silicone varnish impregnates coils.



DRASTIC REDUCTIONS in size and weight are possible with G-E silicones. The tiny autotransformer (right) has been "shrunk" to half former size—yet carries more power.

G-E silicone insulation

NEARLY TWICE THE CURRENT—with no increase in size—is realized in this generator lead cable built with glass cloth coated with G.E.'s SE-100 silicone rubber compound.



LIGHTER, MORE COMPACT DESIGN, plus a new margin of safety through high overload protection, is achieved in this welding transformer made with G-E heat-resistant silicones.

in applications like these

LONGER LIFE for traction-motors on diesel-electric locomotives results from G-E Class H silicone insulation which cuts maintenance costs under severe operating conditions.

YOU'LL FIND IT PAYS TO REQUEST INSULATION MADE WITH G-E SILICONES!

Write for information to:

SILICONE PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
Section 162-1C
WATERFORD, NEW YORK

In CANADA, write to Canadian General Electric Company, Ltd., Toronto

Progress Is Our Most Important Product

GENERAL ELECTRIC

PROFESSIONAL SERVICES

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

BLACK & VEATCH

Consulting Engineers

Electricity—Water—Sewage—Industry

Reports, Design, Supervision of Construction
Investigations, Valuations and Rates

4706 Broadway — Kansas City 2, Missouri

THEODORE D. BROSS LINE CONSTRUCTION CORP.

Steel Tower & Wood
Transmission Lines

Distribution & Maintenance

175 Enfield St. — Hartford, Conn.

DAY & ZIMMERMANN, INC.

Engineers

Design - Construction - Management
Reports and Valuations

New York — Philadelphia — Chicago

Doble Engineering Company

Electrical Insulation Engineers

Field Testing and Maintenance of High Tension Insulation, Special Problems in Electrical Communications

Office and Laboratory: Doble Park
Box 344, Belmont 78, Mass. (6 miles from Boston)
Branch Office: 20 N. Wacker Dr., Chicago, Ill.

ELECTRICAL TESTING LABORATORIES, INC.

Electrical, mechanical, photometric, radiometric and chemical laboratories, rendering testing, research and associated services, including certification, inspections at factories and field investigations.

2 East End Avenue at 79th St., New York 21, N. Y.

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Construction & Maintenance

Transmission—Distribution—Communication Lines
Substation, Radio and Television Towers

48 Griswold St. — Binghamton, N. Y.

FORD, BACON & DAVIS

Engineers

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS

New York • Chicago • Los Angeles

GILBERT ASSOCIATES, Inc.

Engineers • Consultants • Constructors
Reading, Pa.
Engineering and Design • Construction Supervision
Industrial • Sanitary • Safety
Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing

New York — Philadelphia — Washington
Rome — Manila — Medellin

HARZA ENGINEERING CO.

Consulting Engineers

Calvin V. Davis — K. Montford Funk
Richard D. Harza
Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development

400 West Madison Street — Chicago 6

HOOSIER ENGINEERING COMPANY

Erecting Engineers

Transmission Lines, Substations

1384 Holly Avenue, Columbus, Ohio

JACKSON & MORELAND, INC.

Engineers and Consultants

Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications

Boston — New York

M. W. KELLOGG

Piping System Design Analyses

Unique model tester as well as modern digital computer facilities available for low cost, accurate flexibility analyses of the most complex piping systems.

The M. W. Kellogg Company
711 Third Ave., New York 17, N. Y.

THE KULJIAN CORPORATION

Engineers - Constructors - Consultants

POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)

Utility • Industrial • Chemical

1200 N. Broad St., — Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION

Design and Consulting Engineers

Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural

First National Bank Building
Pittsburgh 22, Pennsylvania

N. A. LOUGEE & COMPANY

Engineers and Consultants

REPORTS — APPRAISALS
DEPRECIATION STUDIES—RATE CASES
BUSINESS AND ECONOMIC STUDIES

120 Broadway — New York

LUCAS & LUICK

Engineers

DESIGN, CONSTRUCTION, SUPERVISION, OPERATION, MANAGEMENT, APPRAISALS, INVESTIGATIONS, REPORTS, RATES

231 S. LaSalle St., Chicago

THE LUMMUS COMPANY

Engineers and Constructors

385 Madison Ave., New York, N. Y.

Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

CHAS. T. MAIN, INC.

Engineers

Electric, Steam and Hydraulic Projects, Investigations, Reports, Designs and Appraisals

Chamber of Commerce Building
50 Federal St., Boston 10, Mass.

PIONEER SERVICE & ENGINEERING CO.

Consulting and Design
Engineers. .Purchasing
Specialists in Financing
Accounting and Other Operations

231 So. La Salle St. — Chicago 4

REIS & CHANDLER, INC.

ADVISORS TO UTILITIES

Financing—Rate of Return

30 Vesey Street, — New York 7, N. Y.

SANDERSON & PORTER CONSTRUCTION

Reports — Surveys

New York — New York

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

F. W. SCHEIDENHELM

Consulting Engineer

Hydraulic Engineering, Hydro-electric Development, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals

50 Church Street, — New York 7, N. Y.

SVERDRUP & PARCEL, INC.

Engineers - Architects

Design, Construction Supervision
Steam and Hydro Power Plants
Power Systems - Industrial Plants
Studies - Reports

St. Louis — San Francisco — Washington

F. A. TUCKER, INC.

Contractors—Engineers

specialize in
Distribution - Transmission - Telephone lines - Maintenance - Roads - Bridges Dams

Main Office — 38½ Center Street, Rutland, Vt.
Branch Office — Little Rock Road, Charlotte, N. C.

UTILITIES LINE CONSTRUCTION COMPANY, INC.

Construction and Maintenance

Transmission - Distribution
Electric and Telephone Lines
Consultants

505 York Road — Jenkintown, Pa.

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

Advertising In This Issue

Advance Transformer Co. 11
Allen-Bradley Co. 81, 82
Allis-Chalmers Mfg. Co....4th Cover
41, 42, 43, 44, 51, 216, 217, 242
Aluminum Co. of America.....222, 223
American Brass Co. 219
American Steel & Wire Div., United States Steel Corp....84, 85
Anaconda Wire & Cable Co....92, 93
Anderson Electric Corp..... 203
Asplundh Tree Expert Co..... 183
Atomics International Div., North American Aviation, Inc..... 261
Automatic Lineman Corp..... 241

Babcock & Wilcox Co.....104, 105
Baldwin-Lima-Hamilton Corp. Eddystone Div. 87
Bell Telephone Laboratories..... 91
Bishop Mfg. Corp. 54
Blackburn Corp., Jasper 90
Blaw-Knox Co., Automatic Sprinkler Dept..... 80
Bodendieck Tool Co..... 236
Brewer-Titchener Corp. 52, 53
Bristol Co., The 40
Brown Boveri Corp. 225
Buffalo Forge Co. 28

C & D Batteries Inc. 204
Cable Spinning Equipment Co..... 250
Chance Co., A. B.....214, 215, 228
Chase & Sons, Inc..... 45
Chevrolet Div., General Motors... 58
Clark Controller Co. 55
Coal Chemical Sales Div., United States Steel Corp..... 100
Combustion Engineering Inc...108, 109
Continental-Diamond Fibre Div. The Budd Co., Inc. 72
Continental Wire Corp. 206
Cope Inc., T. J..... 176
Copperweld Steel Co. 73
Cornell-Dubilier Electric Corp 184, 185
Corning Glass Works..... 83
Crescent Tool Co. 60
Crouse-Hinds Co. 103

De Laval Separator Co. 28
Delta-Star Electric Division H. K., Porter Company, Inc.... 179
Diamond Power Specialty Co..... 195
Directory of Engineers..... 266
Dow Chemical Co., The..... 229
duPont de Nemours & Co., (Inc.) Grasselli Chemicals Dept..... 178
Polychemicals Dept. 59

Eastern Specialty Co. 248
Ebasco Services Inc. 46
Electric Service Mfg. Co.....48, 49
Electrical Manufacturing Co..... 70
Elliott Co. 69
Engineers Directory of 266
Exide Industrial Div., The Electric Storage Battery Co. 3rd Cover

Fargo Mfg. Co., Inc..... 205
Federal Pacific Electric Co.....74, 75
76, 77
Flint Steel Corp..... 208
Foster Wheeler Corp.....56, 57
Four Wheel Drive Auto Co..... 65

G & W Electric Specialty Co..... 181
Gar Wood Industries, Inc..... 252
General Cable Corp..... 67
General Electric Co.
Apparatus Dept.....16, 17, 61, 62
63, 64, 151, 152, 153, 154, 156, 157
158, 159, 161, 162, 163, 164, 165, 238
239, 246, 247
Silicone Products Dept..... 265
Graybar Electric Co., Inc..... 5
Grinnell Co., Inc. 9
Guth Co., The Edwin F..... 34

Hazard Insulated Wire Works... 4
Highway Trailer Co..... 38
Holan Corp., J. H..... 71
Holophane Co., Inc. 233
Hotpoint Co. 14, 15
Hubbard & Co. 199
Hughey & Phillips, Inc..... 252

I-T-E Circuit Breaker Co., Switchgear Div. 169
Indiana Steel & Wire Co., Inc.... 182
International Business Machines Corp. 25
International Harvester Co..... 97

Johns-Manville 251
Jones Box Corp., Jesse..... 242

Kaiser Aluminum & Chemical Sales Inc. 98, 99
Kearney Corp., James R..... 101
Kerite Co., The 110
Klein & Sons, Mathias..... 250
Knopp, Inc. 244
Koppers Co., Inc..... 259
Kuhlman Electric Co. 196, 197

Lapp Insulator Co., Inc. 95
Limitorque Corp. 106
Line Material Co....29, 30, 31, 32, 33
Locke Dept., General Electric Co.....78, 79

Macallen Co., The 35
Malleable Iron Fittings Co..... 50
Marcus Transformer Co., Inc..... 228
Minneapolis-Honeywell Regulator Co., Industrial Div.....230, 231
Moloney Electric Co. 18
Monsanto Chemical Co..... 10
Morgan Stanley & Co. 263

Nelson Electric Mfg. Co..... 236
Nordberg Mfg. Co..... 243

Ohio Brass Co. 171, 172, 173, 174
Okonite Co., The 4
Onan & Sons Inc., D. W..... 210

Pacific Coast Borax Co..... 207
Pacific Pumps, Inc. 177
Page Steel & Wire Div., American Chain & Cable..... 244
Palnut Co., The 190
Pennsylvania Transformer Co..23, 24
Permutit Co., The 66

Pfaff & Kendall 94
Philadelphia Gear Works Inc..... 106
Philco Corp. Government & Industrial Div. 12, 13, 167
Pioneer Service & Engineering Co. 68
Pittsburgh Piping & Equipment Co. 102
Porcelain Products, Inc..... 96
Preformed Line Products Co...200, 201

R T & E Corp..... 175
Radio Frequency Laboratories, Inc. 254
Raytheon Mfg. Co. 268
Republic Steel, Steel & Tubes Div. 249
Rockbestos Products Corp..... 237
Rome Cable Corp. 188, 189

S & C Electric Co. 6, 7
Sangamo Electric Co.....27, 37, 235
Sargent & Lundy Engineers..... 218
Searchlight Section 256, 257
Silent Hoist & Crane Co..... 248
Simplex Wire & Cable Co..... 107
Smith & Sons Inc., Seymour..... 254
Southern States Equipment Corp.. 86
Southwire Co. 47
Square D Co. 187
Stone & Webster Engineering Corp. 211

Tel-E-Lect Products, Inc. 220
Texas Co., The.....2nd Cover
Thiel Tool & Engineering Co., Inc. 254
Thomas & Betts Co., The..... 245

Unistrut Products Co. 253
United States Rubber Co.....8, 39
Uptegraff Mfg. Co., R. E..... 36

Victor Insulators Div. I-T-E Circuit Breaker Co..... 209

Wagner Electric Corp.....88, 89
Walker Div. Norma-Hoffmann Bearings Corp. 252
Western Precipitation Corp..... 212
Westinghouse Electric Corp. 191, 192
193, 194, 255
Westinghouse Electric Corp. Lamp Div. 226, 227
Weston Electrical Instrument Corp. 221

York-Hoover Corp. 213

■

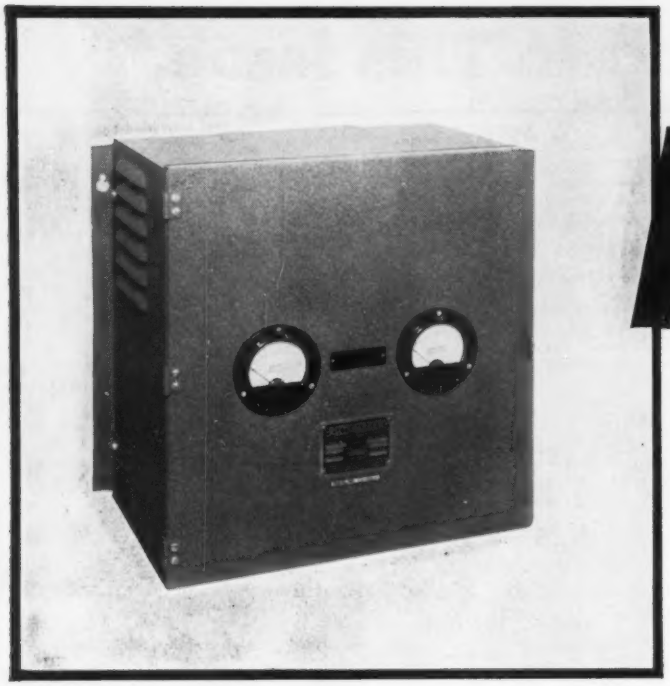
PROFESSIONAL SERVICES.....266

■

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES.....256

EQUIPMENT
(Used or Surplus New)
For Sale.....257



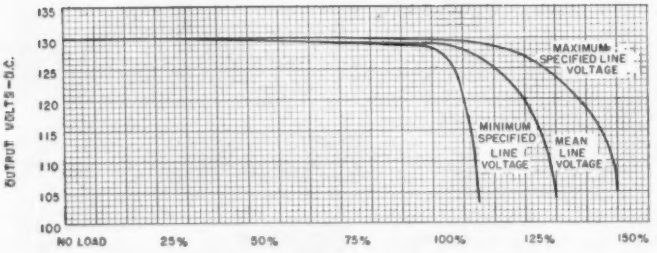
NEW!

Raytheon 60-Cell Battery Charger

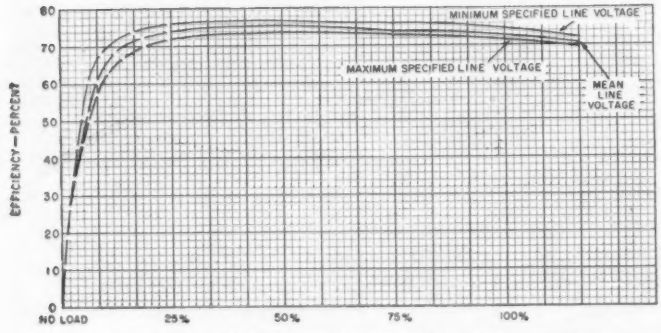
EXTENDS BATTERY LIFE
REDUCES BATTERY MAINTENANCE

IMPORTANT FEATURES

- **Constant potential charging—minimizes battery gassing**
- **Completely static operation—no moving parts**
- **Minimum maintenance—ideal for unattended sub-stations**
- **Rugged magnetic amplifier control circuit**
- **Self-protected—current limiting circuitry**



Regulation Curve (note automatic current limiting at overload to protect equipment)



Efficiency Curve (high efficiency at low loads reduces power consumption)

The new Raytheon 60-cell RectiChargeR® is a constant-potential battery charger specifically designed to maintain utility batteries at full standby potential and to provide maximum battery protection under all conditions. The RectiChargeR lengthens battery life and reduces maintenance, since gassing and water loss due to over or under charging are completely eliminated. Provision for applying periodic "freshening" charges insures uniformly high cell potential at all times.

The 60-cell RectiChargeR utilizes a rugged, magnetic amplifier control circuit which provides regulation to within ±1%. Long life and optimum performance result from completely static operation, self-protecting, current limiting circuitry, and automatic compensation for aging of the conservatively-rated selenium rectifiers.

Available in 3, 6, and 12 ampere models, the 60-cell RectiChargeR is the result of Raytheon's 25 years of experience in the battery charger field. For full information write for Product Data 4-310.

RAYTHEON MANUFACTURING COMPANY

Equipment Marketing Division, Waltham 54, Mass.

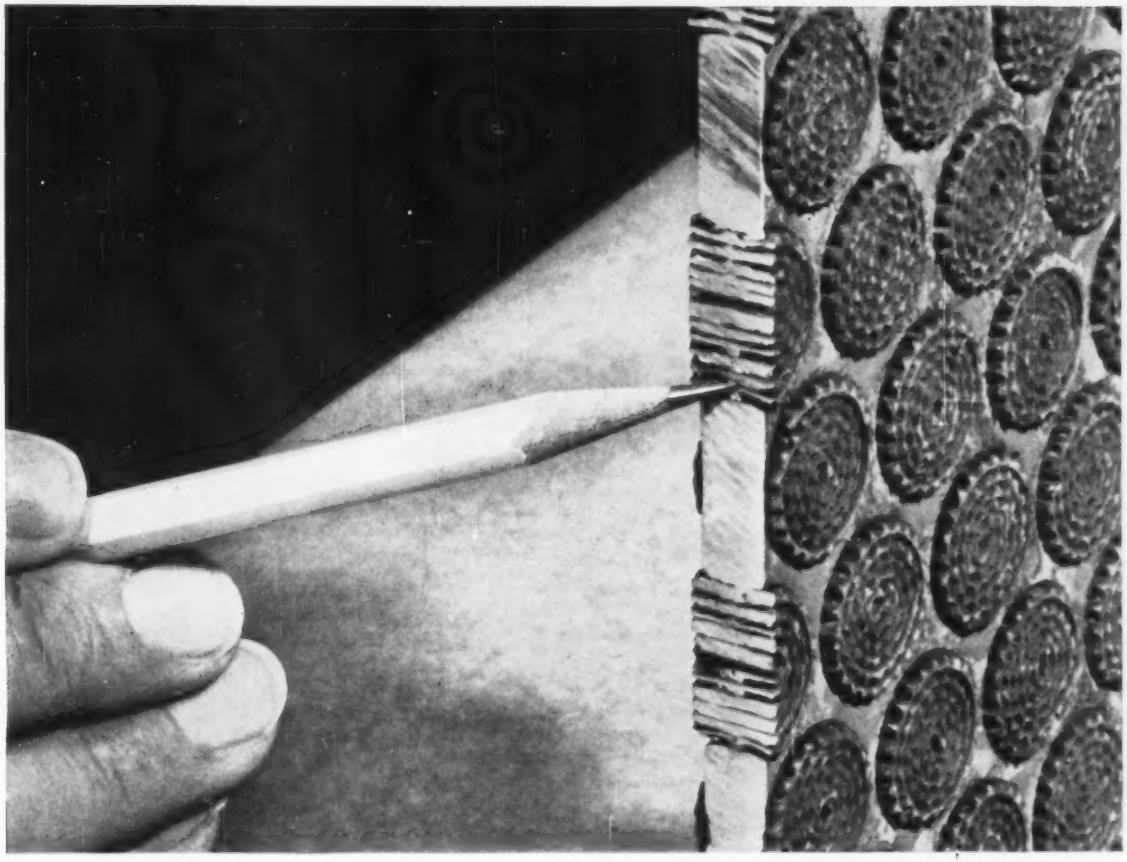
RAYTHEON

A 4012

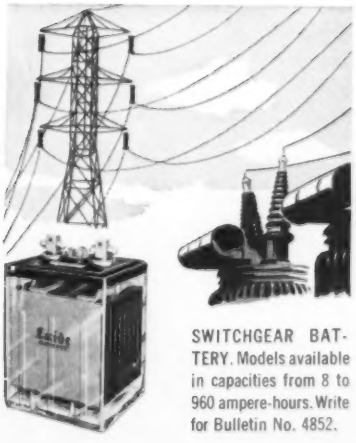
Excellence in Electronics

EXIDE-MANCHEX BATTERIES

Emergency power source for generating and substations



Spiral buttons act like shelves for oxide—prolong battery life



SWITCHGEAR BATTERY. Models available in capacities from 8 to 960 ampere-hours. Write for Bulletin No. 4852.

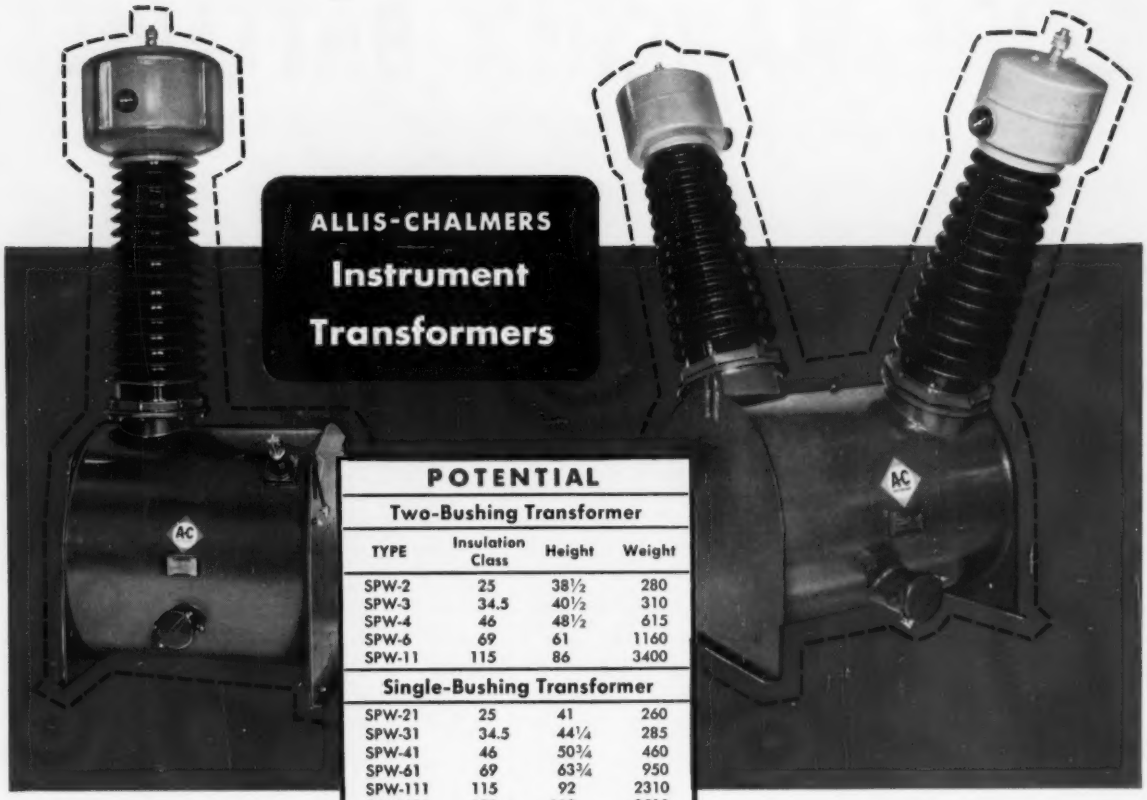
In ordinary batteries, the active material clings to the vertical surfaces of the positive plate—forever fighting the forces of gravity and turbulence. Let it loosen its grip and down it comes. And there goes battery life.

Not so with Exide-Manchex Batteries. Active material is built up between the spiral layers of these unique lead buttons that act like tiny shelves. There it rests, supported against gravity and electrolyte turbulence. And there it stays for years and years and years.

This simple design principle is one of the several tangible reasons for the long, useful life of Exide-Manchex Batteries. Used in a wide variety of floating service applications, these batteries have earned a reputation for long, dependable service unsurpassed in the entire world. And this method of construction is available only in Exide-Manchex Batteries.

When you order batteries for applications where you need dependable performance and long, useful life, or when you buy equipment using this kind of battery, be sure to specify Exide-Manchex Batteries. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pennsylvania.

Exide®



POTENTIAL

TYPE	Insulation Class	Height	Weight
Two-Bushing Transformer			
SPW-2	25	38½	280
SPW-3	34.5	40½	310
SPW-4	46	48½	615
SPW-6	69	61	1160
SPW-11	115	86	3400
Single-Bushing Transformer			
SPW-21	25	41	260
SPW-31	34.5	44¼	285
SPW-41	46	50¾	460
SPW-61	69	63¾	950
SPW-111	115	92	2310
SPW-131	138	112	3510

Advanced Design Features Mean...

Savings in Size and Weight

Now, reductions in size and weight make Allis-Chalmers potential transformers easier to handle — simplify installation procedures.

Compact Design results in improved performance in both ratio and phase angle.

New Ratings. This line of potential transformers has also been expanded to include higher voltage insulation classes.

Advanced Corona-Free Design principles enable these transformers to withstand long continued voltage stresses and short-time surge conditions. Internal corners and coil edges are protected by formed insulating channels which fit close to coil surfaces —effectively prohibiting formation of corona and the development of leakage paths.

Maintenance-Cutting Construction Features are incorporated, such as all-welded, hermetically sealed tanks to extend life of coils and insulation. The new one-piece high voltage porcelain bushing incorporates the same corona-free design features that are used in the transformer, thus assuring long trouble-free life.

Get All the Facts on these modern, lightweight transformers. Contact your nearby Allis-Chalmers district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for more information.

LIVE BETTER ELECTRICALLY

ALLIS-CHALMERS

A-5087

A-C ALLIS-CHALMERS